

Supreme Court, U. S.
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IN THE
Supreme Court of the United States
OCTOBER TERM, 1976

No. **76-548**

BALTIMORE GAS AND ELECTRIC CO., ET AL.,
Petitioners

v.

NATURAL RESOURCES DEFENSE COUNCIL, INC.
and CONSOLIDATED NATIONAL INTERVENORS,
INC.,

Respondents

APPENDIX TO THE PETITION FOR A WRIT OF
CERTIORARI TO THE UNITED STATES COURT OF
APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

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United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 74-1385

**NATURAL RESOURCES DEFENSE COUNCIL, INC., ET AL,
PETITIONER**

v.

**UNITED STATES NUCLEAR REGULATORY COMMISSION AND
UNITED STATES OF AMERICA, RESPONDENTS**

**VERMONT YANKEE NUCLEAR POWER CORPORATION,
INTERVENOR**

No. 74-1586

**NATURAL RESOURCES DEFENSE COUNCIL, INC., AND
CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS**

v.

**UNITED STATES NUCLEAR REGULATORY COMMISSION AND
UNITED STATES OF AMERICA, RESPONDENTS**

BALTIMORE GAS AND ELECTRIC CO., ET AL., INTERVENORS

**Petition for Review of an Order of the
Nuclear Regulatory Commission**

Argued May 27, 1975

Decided July 21, 1976

George W. Mayo, Jr., with whom Robert M. Jeffers, David J. Hensler, Patrick M. Raher, Richard E. Ayres and Anthony Z. Roisman, were on the brief for petitioners in No. 74-1385.

David Hensler and Patrick M. Raher, with whom Robert M. Jeffers, George W. Mayo, Jr., Richard E. Ayres and Anthony Z. Roisman, were on the brief for petitioners in No. 74-1586.

James A. Glasgow, Attorney, U.S. Nuclear Regulatory Commission, with whom Wallace H. Johnson, Assistant Attorney General, Edmund B. Clark, John J. Zimmerman, Attorneys, Department of Justice, Raymond M. Zimmet, Acting Solicitor, U.S. Nuclear Regulatory Commission, were on the brief for respondents. Marcus A. Rowden, Jerome Nelson, Joseph DiStefano and Guy H. Cunningham, III, Attorneys, U.S. Nuclear Regulatory Commission and George R. Hyde and Edward J. Shawaker, Attorneys, Department of Justice, also entered appearances for respondents.

George C. Freeman, Jr., with whom W. Taylor Reveley, III, David S. Brollier and F. Case Whitlemore were on the brief for intervenor, Baltimore Gas and Electric Company in No. 74-1586.

Thomas G. Dignan, Jr., for intervenor, Vermont Yankee Nuclear Power Corporation in No. 74-1385.

Louis J. Lefkowitz, Attorney, General of the State of New York and John F. Shea, III, Assistant Attorney General of the State of New York filed a brief on behalf of the State of New York as *amicus curiae*.

Arvin E. Upton, Harry H. Voight and Eugene R. Fidell, Filed a brief on behalf of Commonwealth Edison Company, Consolidated Edison Company of New York, Inc., Niagara Mohawk Power Corporation, Omaha Public Power District Powers Authority of the State of New

York and Rochester Gas and Electric Corp., as *amici curiae* urging affirmance.

Before: BAZELON, *Chief Judge*, EDWARDS,* *Circuit Judge for the Sixth Circuit* and TAMM, *Circuit Judge*

Opinion for the Court filed by *Chief Judge* BAZELON.

Separate statement of *Chief Judge* BAZELON.

Separate statement filed by *Circuit Judge* TAMM, concurring in the result.

BAZELON, C.J.: The problems posed in both these cases relate to the manner and extent to which information concerning the environmental effects of radioactive wastes must be considered on the public record in decisions to license nuclear reactors.

I. INTRODUCTION

Appeal number 74-1385 involves a proceeding to license a specific nuclear reactor (the Vermont Yankee Nuclear Power Station located near Vernon, Vermont). Pursuant to the National Environmental Policy Act,¹ petitioners²

* Sitting by designation pursuant to 28 U.S.C. § 291 (a).

¹ 42 U.S.C. § 4321, *et seq.* (1970) (hereafter "NEPA").

² Petitioners in 74-1385 are the Natural Resources Defense Council, Inc. ("NRDC") and the New England Coalition on Nuclear Pollution, Inc., voluntary organizations supported by contributions from individual members, which intervened in the licensing proceedings.

NRDC is also a petitioner in 74-1586, where it is joined by Consolidated National Intervenors, Inc. ("CNI"), a coalition of almost eighty public interest groups and individuals which actively participated in the rule making proceedings. Several groups such as the Sierra Club and the Union of Concerned Scientists which are members of CNI also made individual presentations.

[Continued]

sought consideration of the environmental effects of that portion of the "nuclear fuel cycle" attributable to operation of that reactor. The Appeal Board held that Licensing Boards must consider the environmental effects of trans-

Since on all but a few issues these groups adopted the same positions, for convenience they are referred to collectively as "public interest intervenors" in order to distinguish them from a group of 14 utility companies which also actively participated in the rulemaking. One member of that group, Baltimore Gas & Electric Co., has also intervened in the proceedings in this court.

* The "nuclear fuel cycle" is that chain of activities beginning with mining of uranium ore and extending through final reprocessing and disposal of radioactive wastes by which fuel for a nuclear reactor is processed. Most of these events take place off the individual reactor site, but are necessary to its continued operation.

Although the nuclear fuel cycle encompasses numerous stages, these cases are concerned almost exclusively with the reprocessing and disposal of wastes which the public interest intervenors contend account for by far the largest portion of the environmental impact of the fuel cycle.

The word *disposal* may itself be misleading, for it connotes some physical or chemical step which renders the wastes less toxic. Under present technology, the only known agent of detoxification is the passage of great amounts of time. The phase of the nuclear fuel cycle referred to as "disposal" generally refers only to storage of wastes in physical isolation.

* Licensing of commercial nuclear reactors embraces two separate proceedings—the first to determine whether the facility should be constructed; the second to determine whether it should be licensed to operate. See generally, *Power Reactor Development Corp. v. I.U.E.W.*, 367 U.S. 396 (1961).

Proceedings are conducted before a three-member Atomic Safety and Licensing Board, 42 U.S.C. § 2241, which is the counterpart of an Administrative Law Judge in other agencies. The Licensing Board is typically composed of two nuclear physicists and one lawyer who serves as chairman.

[Continued]

portation of fuel to a reactor and of wastes to reprocessing plants, but need not consider the "operations of the reprocessing plants or the disposal of wastes" in individual licensing proceedings. *In re Vermont Yankee Nuclear Power Corp.*, ALAB-56, 4 AEC 930 (June 6, 1972), I-J.A. 72, 76.*

Appeal number 74-1586 involves a rulemaking proceeding which the Commission instituted shortly thereafter with specific reference to the *Vermont Yankee* decision. The purpose of the rulemaking was to reconsider whether environmental effects of all stages of the uranium fuel cycle should be included in the cost-benefit analysis for licensing individual reactors. 37 Fed.Reg. 24191 (Nov. 15, 1972), II-J.A. 1. The Commission concluded the environmental effects of the fuel cycle, including waste disposal, were "relatively insignificant,"* but that it was preferable to take them into account. Therefore, a rule was promulgated requiring a series of specified numerical values (set out as Table S-3 accompanying the rule) be factored into the cost-benefit analysis

The Atomic Energy Commission ("AEC") has delegated its review functions over Licensing Board decisions to Atomic Safety and Licensing Appeal Boards, subject to discretionary determination by the AEC itself of "major or novel questions of policy, law or procedure." 10 C.F.R. § 2.785(a); *id.* (d) (1).

The AEC was abolished by the Energy Reorganization Act of 1974, 88 Stat. 1233 *et seq.*, and its functions divided between the United States Nuclear Regulatory Commission (NRC), which has been substituted as formal respondent by order of this court, and the Energy Research and Development Agency (ERDA). For consistency, the terminology AEC or "the Commission" is used throughout.

* References to the joint appendix in 74-1385 are in the form "I-J.A." Both volumes of the appendix in 74-1586 are referred to as "II-J.A."

* See *infra* note 19.

for an individual reactor. These values are intended to represent the incremental contribution of an additional reactor to the environmental effect of the fuel cycle. The rule further provides that in addition to Table S-3, "No further discussion of such environmental effects shall be required."⁷ Finally, it is declared that "[i]nsofar as this rule differs" from that announced in the *Vermont Yankee* decision, *supra*, that decision shall have "no further precedential significance." *Id.*

II. VERMONT YANKEE (74-1385)

It is undisputed that a reactor licensing is a "major Federal action[]" significantly affecting the quality of the human environment" which requires a "detailed" environmental impact statement under § 102(2)(C) of NEPA, 42 U.S.C. § 4332(2)(C). That section requires an impact statement to consider, *inter alia*,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

* * *

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

The plain meaning of this language encompasses radioactive wastes generated by the operations of a nuclear power station, just as it does the stack gases produced by a coal-burning power plant.

Nor are the wastes generated by the subject reactor *de minimis*. We were informed at argument that the Vermont Yankee plant will produce approximately 160 pounds of plutonium wastes annually during its 40-year

⁷ 39 Fed.Reg. 14188, 14191 (April 22, 1974), II-J.A. 507, 509. The rule is codified as Part 51.20(e) of 10 C.F.R. (1975) in a section entitled "Applicant's Environmental Report—Construction Permit Stage."

life span.⁸ Plutonium is generally accepted as among the most toxic substances known; inhalation of a single microscopic particle is thought to be sufficient to cause cancer.⁹ Moreover, with a half-life of 25,000 years, plutonium must be isolated from the environment for 250,000 years before it becomes harmless. Operation of the facility in question will also produce substantial quantities of other "high-level"¹⁰ radioactive wastes in the form of stron-

* There has been some disagreement between the parties concerning the exact amounts of wastes to be produced. We are required to consider projects from the perspective of their potential effect on the "quality of the human environment." 42 U.S.C. § 4332(2)(C). Since plutonium and other high level wastes may be toxic in extremely small quantities, these variances are not of an order which would affect our conclusions.

⁸ See Luschbauch & Langham, *A Dermal Lesion from Implanted Plutonium*, 86 ARCHIVES OF DERMATOLOGY at 121-24 (Oct. 1962).

The dangers of plutonium must be kept in perspective. Certain industrial chemicals and substances common in laboratories may be equally toxic. B. Cohen, *Environmental Hazards in High-Level Radioactive Waste Disposal*, 2 (unpublished). Recent theoretical calculations suggest many would survive even intentional dispersal of plutonium over a city. B. Cohen, *The Hazards in Plutonium Dispersal*, Institute for Energy Analysis, Oak Ridge, Tenn. (1975). See also Bethe, *The Necessity of Fission Power*, 234 SCIENTIFIC AMERICAN 21, 29 (1976).

¹⁰ According to a pamphlet published by the AEC's office of Information to inform the general public, "high-level" wastes consist primarily of highly radioactive spent reactor fuel containing "several hundred to several thousand curies per gallon in liquid form" Fox, *Radioactive Waste*, AEC No. IB-508, 14-15 (rev. ed. 1969). They "pose the most severe potential health hazard and the most complex technical problems in management," *id.*, and thus attracted the bulk of the attention in these proceedings.

Less radioactive "low-level" wastes are also produced, primarily when objects such as pipes, rags or other debris are exposed to radioactivity produced in the reactor core. Low-

tium-90 and cesium-137 which, with their shorter, 30-year half-lives, must be isolated from the environment for "only" 600 to 1000 years.¹¹

The Appeal Board advanced two major arguments to justify its decision that reprocessing and waste disposal issues need not be considered at the licensing stage: (1) that these issues are too speculative; and (2) that they are more appropriately considered when reprocessing and waste disposal facilities are themselves licensed. We turn now to these contentions.

The Board agreed that "there will be an incremental environmental effect ultimately resulting from the operation of this reactor as the result of the operation of whatever reprocessing and disposal grounds may from time to time be used during the life of the plant."¹² In its opin-

level wastes have long been disposed of in commercial burial grounds and were thought not to constitute a major problem. Recently, however, EPA and GAO have publicly reported radioactive material has been "migrating" from such facilities at a rate "much more rapid than scientists thought possible." See "New Alarms About Old Nuclear Wastes," BUSINESS WEEK (Feb. 2, 1976) at 17; "GAO Reports New Nuclear Garbage Problem," 6 SCIENCE & GOV. RPT. 8 (Feb. 1, 1976).

¹¹ The general outlines of the high-level waste disposal problem are undisputed. In *Scientists' Institute for Public Information, Inc. v. AEC* ("SIPI"), 156 U.S.App.D.C. 395, 481 F.2d 1079, 1098 (1973), this court observed:

These wastes will pose an admitted hazard to human health for hundreds of years, and will have to be maintained in special repositories. *The environmental problems attendant upon processing, transporting and storing these wastes . . . warrant the most searching scrutiny under NEPA.* [Emphasis added.]

¹² I-J.A. 80. We note at the outset that this standard is misleading because the toxic life of the wastes under discussion far exceeds the life of the plant being licensed. The

ion, however, these effects were too "contingent and presently indefinable" to be evaluated at the time of licensing in view of the 40-year expected life of the reactor. The Board wrote:

It is evident to us that evaluation of the environmental effects of the operation of one or more unidentifiable reprocessing plants, employing separation processes which are unidentified and which may or may not now be known or used, during the course of the forty-year life of the plant, is not possible at this time and in this proceeding.

I-J.A. 82. This approach was decisively rejected in *SIPI*, supra, note 11, 481 F.2d at 1092. There we held that the obligation to make reasonable forecasts of the future is implicit in NEPA and therefore an agency cannot "shirk [its] responsibilities under NEPA by labeling any and all discussion of future environmental effects as 'crystal ball inquiry.'" "Meaningful information" concerning the effects of waste reprocessing and disposal technology is presently available, see *SIPI*, 481 F.2d at 1094, 1096. As the Board noted, a reprocessing plant has been operated by the Commission for some time, and additional plants are under construction. I-J.A. 79. The possibility that

environmental effects to be considered are those flowing from reprocessing and passive storage for the full detoxification period.

It is also misleading to focus solely on the *incremental* impact of the waste generated by an additional reactor. See *NRDC v. Callaway*, 524 F.2d 79, 88 (2d Cir. 1975):

[A]n agency may not . . . treat[] a project as an isolated "single-shot" venture in the face of persuasive evidence that it is but one of several substantially similar operations. . . . To ignore the prospective cumulative harm under such circumstances could be to risk ecological disaster.

See also *Kleppe v. Sierra Club*, 44 U.S.L.W. 5104, 5109 (U.S., June 28, 1976) (Comprehensive EIS should address cumulative impact of proposals "pending concurrently"); cf. *id.* at 5111 n.26.

improved technology may be developed during the 40-year life span of a reactor does not render consideration of environmental issues too speculative, as the Board appears to suggest. NEPA's requirement for forecasting environmental consequences far into the future implies the need for predictions based on existing technology and those developments which can be extrapolated from it.¹³

As more and more reactors producing more and more waste are brought into being, "irretrievable commitments [are] being made and options precluded," see *SIFI*, 481 F.2d at 1094, 1098, and the agency must predict the environmental consequences of its decisions as it makes them. See *Aberdeen & Rockfish R.R. v. SCRAP*, 422 U.S. 289, 320 (1975).

The second argument advanced by the Board is that licensing proceedings for reprocessing plants are a more "appropriate proceeding" in which to weigh the environmental effects of reprocessing and waste disposal. I-J.A. 86. Licensing of a reprocessing plant or waste disposal facility is itself a "major Federal action" affecting the environment which requires a NEPA statement. The real question posed by the Board's opinion is whether the environmental effects of the wastes produced by a

¹³ Technical breakthroughs not now foreseen may of course render these assumptions too conservative, and environmental costs may turn out to be less than expected. The alternative is to rest on a blind faith in technological progress. This the draftsmen of NEPA were quite evidently unwilling to do.

Conversely, unforeseen problems sometimes crop up to forestall anticipated technological solutions. See, e.g., *infra* notes 46 & 47. Where important changes in the state of the art or other major uncertainties are in the offing, meaningful assessments of future environmental impacts might be facilitated by making two alternative estimates: one based only on existing technology and another which takes into account developments which may reasonably be anticipated. We have no occasion in this case to decide whether a court could ever require such a procedure.

nuclear reactor may be ignored in deciding whether to build it because they will later be considered when a plant is proposed to deal with them. To answer this question any way but in the negative would be to misconstrue the fundamental purpose of NEPA.¹⁴ Once a series of reactors is operating, it is too late to consider whether the wastes they generate should have been produced, no matter how costly and impractical reprocessing and waste disposal turn out to be; all that remain are engineering details to make the best of the situation which has been created.¹⁵ NEPA's purpose was to break the cycle of such incremental decision-making:

¹⁴ Cf. *Calvert Cliffs' Coordinating Comm. v. AEC*, 449 F.2d 1109, 1128 (D.C.Cir. 1971). There the Commission proposed to forestall consideration of environmental issues in granting reactor construction permits until an operating license was issued. This court pointed out: "Once a facility has been completely constructed, the economic cost of any alteration may be very great By refusing to consider requirement of alterations until construction is completed, the Commission may effectively foreclose the environmental protection desired by Congress."

¹⁵ Intervenor Baltimore Gas & Electric Co. contended at argument "however broad NEPA may be, it does not require agencies like the AEC, ICC or CAB to examine in the impact statement the very reason for being of that agency." We have already rejected that argument in *Natural Resources Defense Council v. Morton*, 458 F.2d 827, 836 (D.C.Cir. 1972): "The need for continuing review of environmental impact of alternatives under NEPA cannot be put to one side on the ground of past determinations by Congress or the President." See also *Calvert Cliffs' Coordinating Comm. v. AEC*, *supra* note 14, 449 F.2d at 1127. One function of NEPA is to provide systematic feedback to Congress and the public on the environmental costs of implementing programs so that they may be re-evaluated in the light of experience.

Moreover, the "reason for being" of the agencies administering the Atomic Energy Act of 1954 has never been unlimited development of civilian nuclear power without re-

Policy is established by default and inaction. Environmental problems are only dealt with when they reach crisis proportion Important decisions concerning the use and shape of man's environment continue to be made in small but steady increments which perpetuate rather than avoid the recognized mistakes of previous decades.

Senate Rep. No. 296, 91st Cong., 1st Sess. 5 (1969). Decisions to license nuclear reactors which generate large amounts of toxic wastes requiring special isolation from the environment for several centuries are a paradigm of "irreversible and irretrievable commitments of resources" which must receive "detailed" analysis under § 102(2)(C)(v) of NEPA, 42 U.S.C. § 4332(2)(C)(v).¹⁶ We therefore hold that absent effective generic proceedings to consider these issues, they must be dealt with in individual licensing proceedings.¹⁷

gard to the costs or risks. The Congressionally declared purpose is only to "encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with . . . the health and safety of the public." 42 U.S.C. § 2013(d) (1970) [emphasis added].

¹⁶ No one suggests that the two sentence statement in the Vermont Yankee Final Environmental Impact Statement is adequate to satisfy § 102(2)(c). It reads:

Long-lived radioactive materials will be produced by fission of nuclear fuel in the core of the reactor and neutron activation of reactor parts near the core. The eventual disposal and storage of radioactive materials will require a certain amount of space, probably in an area remote from this plant, for a very long period of time, and could for all practical purposes be considered as an irreversible commitment of resources.

I-J.A. 263.

No attempt is made to estimate the quantity of wastes produced, describe what precautions must be taken, or assess the costs and risks involved.

¹⁷ When the final full-power, full-term operating license for the Vermont Yankee Nuclear Power Station was issued, the

The order granting a full-term license for the Vermont Yankee plant is hereby remanded to await the outcome of further proceedings in the rulemaking, discussed hereafter.

III. RULEMAKING (74-1586)

(A.)

The notice of proposed rulemaking, 37 Fed.Reg. 24191 (Nov. 15, 1972), suggested as a possible alternative to the rule of *Vermont Yankee*, *supra*, that a series of specified numerical values (set out as Table S-3 in the notice) be factored into the cost-benefit analysis for individual

Appeal Board "declined to re-examine" its earlier holdings that reprocessing and waste disposal issues need not be considered, since the rulemaking proceeding was then pending. I-J.A. 495-96. As a result, the Government argues the only issue raised is "whether the Commission under the National Environmental Policy Act (NEPA) could deal with fuel cycle issues by rulemaking, instead of in the context of numerous separate adjudications, such as the Vermont Yankee licensing proceeding." Respondent's brief at 5.

No one questions the AEC's power to do so in this proceeding. *Cf.* Union of Concerned Scientists v. AEC, 499 F.2d 1069 (D.C.Cir. 1974). Nor do we doubt that generic proceedings are a more efficient forum in which to develop these issues without needless repetition and potential for delay. *See Ecology Action v. AEC*, 492 F.2d 998, 1002 (2d Cir. 1974) (Friendly, J.) (dictum); Note, "The Use of Generic Rulemaking to Resolve Environmental Issues in Nuclear Power Plant Licensing," 61 VA.L.REV. 869, 878-79 (1975). However, the decision to hold generic proceedings rather than to leave these issues for individual licensings is left to agency discretion. *See infra* note 27.

What the agency may not do, consistent with NEPA, is to fail to give these issues adequate consideration in either forum. Thus, until an adequate generic proceeding is held (which may also consolidate a number of pending cases, *see, e.g.,* Specialized Common Carrier Services, 29 F.C.C. 870 (1971)), these issues will be ripe in individual licensing proceedings.

reactors.¹⁸ These values were intended to represent the

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TABLE S-3. Summary of environmental considerations for uranium fuel cycle

[Normalized to model LWR annual fuel requirement]

Natural resource use	Total	Maximum effect per annual fuel requirement of model 1,000 MWe LWR
Land (acres):		
Temporarily committed	68	
Undisturbed area	43	
Disturbed area	18	Equivalent to 90 MWe coal-fired powerplant.
Permanently committed	4.8	
Overburden moved (millions of MT)	2.7	Equivalent to 90 MWe coal-fired powerplant.
Water (millions of gallons):		
Discharged to air	188	
Discharged to water bodies	11,040	~3 percent model 1,000 MWe LWR with cooling tower.
Discharged to ground	120	
Total	11,310	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MWh)	217	<3 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	218	Equivalent to the consumption of a 45 MWe coal-fired powerplant.
Natural gas (millions of cu ft)	88	<0.5 percent of model 1,000 MWe energy output.
Emissions—chemical (MT):		
Gases (including entrainment): ¹		
SO ₂	4,400	
NO _x	1,177	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	12.8	
CO	28.7	
Particulates	1,168	
Other gases	.73	Primarily from UF ₆ production enrichment and reprocessing. Concentration within range of state standards—below level that has effects on human health.
Liquids:		
SO ₂	12.8	From enrichment, fuel fabrication, and reprocessing steps.
NO _x	28.7	Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are:
Fluoride	12.9	NH ₃ —600 cu ft
Ca ⁺⁺	4.4	NO _x —20 cu ft
Cl ⁻	4.4	Fluoride—70 cu ft
Na ⁺	14.9	
CH ₄	11.8	
H ₂	.4	
Tailings solutions (thousands of MT):	240	From mills only—no significant effluents to environment.
Solids:	61,000	Primarily from mills—no significant effluents to environment.
Emissions—Radiological (curies):		
Gases (including entrainment):		
Ra-226	.38	Primarily from mills—maximum annual dose rate <4 percent of average natural background within 5 mi of mill. Results in 0.06 man-rem per annual fuel requirement.
Ra-228	.02	
Th-230	.02	
Uranium	.028	
Tritium (thousands)	16.7	Primarily from fuel reprocessing plants—Whole body dose is 6 man-rem per annual fuel requirements for population within 50 mi radius. This is <0.007 percent of average natural background dose to this population. Release from Federal Waste Repository of 0.005 CV/yr has been included in fission products and transuranics total.
Kr-85 (thousands)	250	
I-129	.0024	
I-131	.004	
Fission products and transuranics	1.01	
Liquids:		
Uranium and daughters	2.1	Primarily from milling—included in tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra-226	.0004	From UF ₆ production—concentration 8 percent of 10 CFR 20 for total processing of 27.5 model LWR annual fuel requirements.
Th-230	.0005	
Th-232	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 20 annual fuel requirements for model LWR.
Ra-226 ²	.15	From reprocessing plants—maximum concentration 4 percent of 10 CFR 20 for total reprocessing of 20 annual fuel requirements for model LWR.
Tritium (thousands)	1.6	
Solids (buried):		
Other than high level	68	All except 1 Ci comes from mills—included in tailings returned to ground—no significant effluent to the environment. 1 Ci from conversion and fuel fabrication is buried.
Thermal (million Btu):	2,300	<3 percent of model 1,000 MWe LWR.
Transportation (man-rem): Expenses of workers and general public	.004	

¹ Estimated effluents based upon combustion of equivalent coal for power generation.

² 1.5 percent from natural gas use and process.

³ Co-60 (0.004 Ci/LWR) and Ra-226 (0.004 Ci/LWR) are also emitted.

incremental contribution of a hypothetical 1000 MWe model light water reactor to the total environmental effect of the uranium fuel cycle. While expressed as numerical values in Table S-3, a fair summary of the conclusions incorporated into the rule is that the environmental effects of the fuel cycle are "insignificant." The notice further stated that the "supporting data for this summary table" is contained in a staff document entitled the "Environmental Survey of the Nuclear Fuel Cycle" (Nov. 6, 1972) [hereafter "Environmental Survey"], which was simultaneously made public.³⁰

An "informal rulemaking hearing" of the "legislative-type" was scheduled to receive comments in the form of "oral or written statements."³¹ By subsequent notice, the Commission designated a three-member hearing board to preside, and reiterated, "The procedural format for the hearing will follow the legislative pattern, and no discovery or cross-examination will be utilized." 38 Fed. Reg. 49 (Jan. 3, 1973).³²

³⁰ In explaining its decision not to require Table S-3 to be applied retroactively, the Commission stated:

In view of the fact that the environmental effects of the uranium fuel cycle have been shown to be relatively insignificant, the Commission believes that it is unnecessary to apply the [rule] to . . . environmental reports submitted prior to its effective date. . . .

39 Fed. Reg. 14190 (April 22, 1974); II-J.A. 508.

³¹ 37 Fed. Reg. 24192 n.1; *id.*, 24193.

It is conceded that the Environmental Survey was not "intended to be a detailed environmental statement as defined in the National Environmental Policy Act of 1969. . . ." I-J.A. 512; 39 Fed. Reg. 14188 (April 22, 1974), II-J.A. 507.

³² 37 Fed. Reg. 24191 (Nov. 15, 1972).

³³ It should be noted that members of the presiding hearing board were empowered to ask questions, and occasionally did. In addition, "over 100 pages of handwritten calculations" and

The primary argument advanced by the public interest intervenors is that the decision to preclude "discovery or cross-examination" denied them a meaningful opportunity to participate in the proceedings as guaranteed by due process. They do not question the Commission's authority to proceed by informal rulemaking, as opposed to adjudication. They rely instead on the line of cases indicating that in particular circumstances procedures in excess of the bare minima prescribed by the Administrative Procedure Act, 5 U.S.C. § 553, may be required.²²

prior drafts of the Environmental Survey were eventually placed in the public document room. 39 Fed.Reg. 14190-91 (April 22, 1974).

None of these documents, however, dealt with the crucial waste disposal issues covered by Dr. Pittman, *see infra* pp. 23-32.

²² *See, e.g.,* Mobil Oil Corp. v. FPC, 157 U.S.App.D.C. 235, 483 F.2d 1238, 1260 (1973); International Harvester Co. v. Ruckelshaus, 155 U.S.App.D.C. 411, 478 F.2d 615, 629-31, 649 (1973); Appalachian Power Co. v. EPA, 477 F.2d 495, 503 (4th Cir. 1973); Walter Holm & Co. v. Hardin, 145 U.S.App.D.C. 347, 449 F.2d 1009, 1016 (1971); American Airlines, Inc. v. CAB, 123 U.S.App.D.C. 310, 359 F.2d 624, 632-33 (en banc), *cert. denied*, 385 U.S. 843 (1966).

See also, Williams, "Hybrid Rulemaking" under the Administrative Procedure Act: A Legal and Empirical Analysis, 42 U.CHI.L.REV. 401 (1975); Wright, *Court of Appeals Review of Federal Regulatory Agency Rulemaking*, 26 ADMIN. L.REV. 199 (1974); Wright, *The Courts and the Rulemaking Process: The Limits of Judicial Review*, 59 CORNELL L.REV. 375 (1974). Verkuil, *Judicial Review of Informal Rulemaking*, 60 VA.L.REV. 185, 234-49 (1974); Note, *The Judicial Role in Defining Procedural Requirements for Agency Rulemaking*, 87 HARV.L.REV. 782 (1974); Hamilton, *Procedures for the Adoption of Rules of General Applicability: The Need for Procedural Innovation in Administrative Rulemaking*, 60 CALIF.L.REV. 1276, 1313-30 (1972); Claggett, *Informal Action—Adjudication—Rulemaking: Some Recent Developments in Federal Administrative Law*, 1971 DUKE L.J. 51, 78.

The Government concedes that "basic considerations of fairness may under exceptional circumstances" require additional procedures in "legislative-type proceedings," but contends that the procedures here were more than adequate.²⁴ Thus, we are called upon to decide whether the procedures provided by the agency were sufficient to ventilate the issues.²⁵

²⁴ Respondent's brief at 13-14.

²⁵ We disagree with Intervenor Baltimore Gas & Electric Co.'s threshold objection that the public interest intervenors failed to make a proffer of the specific issues and witnesses which they claimed could not adequately be explored without cross-examination as required by *International Harvester Co. v. Ruckelshaus*, *supra* note 23, 478 F.2d at 630-31; *see also* *American Airlines v. CAB*, *supra* note 23, 359 F.2d at 632-33. The public-interest intervenors submitted a thorough legal brief demanding cross-examination and discovery rights. CNI-UCS Statement with Respect to Legal Considerations of the Proposed Regulations on the Nuclear Fuel Cycle, 20-29; II-J.A. 225, 245, 254. The first point made by Mr. Roisman, attorney for the public interest intervenors, in the oral hearings was a request to be allowed to go behind the reassurances offered by Dr. Pittman:

The Atomic Energy Commission continues to take subjects as important as nuclear waste disposal and treat them in a cavalier manner that we find them treated in this environmental survey. They continue to raise the issues of the environmental [sic] fuel cycle in the most obtuse manner, and subject it to this type of a legislative hearing, while refusing to face up to the fact that the public demands the right to cross-examine and to have discovery on these issues, that we are not satisfied with Mr. Pittman's well intentioned, but, we think, not at all well explained position with regard to the ability to handle nuclear wastes for hundreds of thousands of years. He has in his own words referred to it as a program of perpetual management I think the public deserves the right to ask the question, What does that mean?

II-J.A. 121-22. That was sufficient to focus the agency's at-

A few general observations are in order concerning the role of a court in this area. Absent extraordinary circumstances, it is not proper for a reviewing court to prescribe the procedural format which an agency must use to explore a given set of issues.²⁶ Unless there are statutory directives to the contrary, an agency has discretion to select procedures which it deems best to compile a record illuminating the issues.²⁷ Courts are no more expert at fashioning administrative procedures than they are in

tention on Dr. Pittman's testimony as in the category of "soft and sensitive subjects and witnesses." *International Harvester, supra*, 478 F.2d at 631. *See infra*, pp. 32-33.

To be sure, the public interest intervenors did not show that these issues could not be explored except through cross-examination; nor did they attempt such a showing. Their argument, as we understand it, is not that cross-examination was required *per se*, but that the procedures utilized by the Commission were in the aggregate inadequate sufficiently to ventilate the issues. They recognize, for example, that exploration of the underlying methodology of the Environmental Survey could have been facilitated by adequate discovery, as an alternative to cross-examination of the staff. *See* Petitioner's Brief, 13-15.

²⁶ The Supreme Court has recently cautioned against requiring an agency to use particular procedures on remand:

At least in the absence of substantial justification for doing otherwise, a reviewing court may not, after determining that additional evidence is requisite for adequate review, proceed by dictating to the agency the methods, procedures, and time dimension of the needed inquiry and ordering the results to be reported to the court without opportunity for further consideration on the basis of the new evidence by the agency.

FPC v. Transcontinental Gas Pipe Line Corp., 96 S.Ct. 579, 583 (1976) (per curiam) [footnote omitted].

²⁷ *See* *NLRB v. Bell Aerospace Co.*, 416 U.S. 267, 292-95 (1974); *SEC v. Chenery Corp.*, 332 U.S. 194, 203 (1947) (*Chenery II*); *Siegel v. AEC*, 400 F.2d 778, 783 (D.C.Cir. 1968).

the substantive areas of responsibility which are left to agency discretion.²⁸ What a reviewing court can do, however, is scrutinize the record as a whole to insure that genuine opportunities to participate in a meaningful way were provided, and that the agency has taken a good, hard look at the major questions before it.

We have sometimes suggested that elucidation of certain types of issues, by their very nature, might require particular procedures, including cross-examination.²⁹ In fact, we have been more concerned with making sure that the record developed by agency procedures discloses a thorough ventilation of the issues than with what devices the agency used to create the dialogue.³⁰

²⁸ That may be reflected in the finding that in most cases where the right to cross-examination was won on appeal, it was not actually used on remand, the parties instead agreeing on more flexible procedures such as written memoranda explaining technical methodology or informal staff conferences which better suited their needs. *See* Williams, *supra* note 23, 42 U.C.H.L.REV. at 436-37; 448-54.

²⁹ *See, e.g.*, *International Harvester v. Ruckelshaus, supra* note 23, 478 F.2d at 631 ("soft and sensitive subjects and witnesses"); *but cf.* *O'Donnell v. Shaffer*, 160 U.S.App.D.C. 266, 491 F.2d 59, 62 (1974) (Bazelon, C.J.): "the presence of technical issues in and of itself [does not] create a need for cross-examination."

³⁰ *See, e.g.*, *Walter Holm & Co. v. Hardin, supra* note 23, 449 F.2d at 849: "What counts is the reality of an opportunity to submit an effective presentation, to assure that the Secretary and his assistant will take a hard look at the problems in light of those submissions."; *International Harvester v. Ruckelshaus, supra* note 23, 478 F.2d at 631: "There was a meaningful opportunity to be heard. . . . The record reveals that the hearing officers did not propound the pre-submitted questions like robots; they were charged with conducting a hearing for the purpose of focusing information needed for decision and they quite appropriately 'followed up' on questions."; *O'Donnell v. Shaffer, supra* note 23, 491 F.2d at 62: "Here the agency's proceedings provided an adequate oppor-

Of necessity, assessing agency procedures requires that the reviewing court immerse itself in the record. Abstract characterizations are an unsatisfactory guide for determining what procedures are necessary in particular proceedings.²¹ Alternative procedural techniques are usually available, and the absence of one device, such as cross-examination, may be compensated for by the sensitive use

tunity for the airing of technical disputes. Appellants presented their evidence orally and in writing and questioned a supporter of the rule who testified at the hearing. The agency considered the evidence presented at the hearing in its 'Disposition of Petition.' On these facts, the procedures were adequate for the task at hand." *Ethyl Corp. v. EPA*, No. 73-2205 (D.C. Cir., March 19, 1976) (en banc) (opinion of Wright, J.), slip op., 119-22, — F.2d —, —, cert. denied, 44 U.S.L.W. 3719 (June 10, 1976), reviewing in detail the procedures used and the agency's lengthy opinion and concluding: "The complex scientific questions presented by this rulemaking proceeding were resolved in the crucible of debate through the clash of informed but opposing scientific and technological viewpoints." [Citation omitted.]

²¹ See Wright, *supra* note 23, 26 ADMIN.L.REV. at 206-7; *id.*, 59 CORNELL L.REV. at 387-88.

Judge Tamm professes surprise that one who believes judges must avoid making "plausible-sounding, but simplistic, judgments of the relative weight to be afforded various pieces of technical data," *Ethyl Corp. v. EPA*, *supra* note 30 (Bazelon, C.J., concurring), slip op., 2, nonetheless believes review of agency procedures requires conscientious attention to the state of the record. Concur, n. 7.

There is, however, a difference crucial to the institutional competency of judges between the majority opinion here and the panel opinion, joined by Judge Tamm, which was overturned by the court *en banc* in *Ethyl*. The panel in *Ethyl* took it upon itself to decide that an expert agency had made "clear errors of judgment" in evaluating conflicting scientific studies. Slip op., 48. Here we merely systematically catalog the state of the record to verify that the agency has digested and addressed the major issues.

of substitutes.²² If review is to be meaningful, it must focus on the actual operation of the whole range of procedures in a particular setting—including "contexts of fact, statutory framework, and nature of action."²³

A prominent feature of the statutory context created by NEPA is the requirement that the agency acknowledge and consider "responsible scientific opinion concerning possible adverse environmental effects" which is contrary to the official agency position. (*see, e.g., infra* note 51). *Committee for Nuclear Responsibility, Inc. v. Seaborg*, 463 F.2d 783, 787 (D.C. Cir. 1971). NEPA requires that agencies see to it that "the officials making the ultimate decision [are] informed of the full range of responsible opinion on the environmental effects in order to make an informed choice." *Id.* The decision to proceed by rule-making neither relieves the Commission of this obligation, nor permits it to depend solely on whatever contributions intervenors happen to make to develop a fair representation of scientific opinion for the record.²⁴

²² See *International Harvester v. Ruckelshaus*, *supra* note 23, 478 F.2d at 631.

²³ *Kennecott Copper Corp. v. EPA*, 149 U.S.App.D.C. 231, 235, 462 F.2d 846, 850 (1972).

²⁴ At least in the NEPA context, an agency has an affirmative obligation to explore the issues in depth, rather than wait passively until an intervenor takes the initiative. See *Calvert Cliffs' Coordinating Comm. v. AEC*, *supra* note 14, 449 F.2d at 1118-19. There the Commission proposed to limit consideration to environmental issues "which parties affirmatively raise." The court held that was inconsistent with NEPA's "basic mandate":

The primary responsibility for fulfilling that mandate lies with the Commission. Its responsibility is not simply to sit back, like an umpire, and resolve adversary contentions at the hearing stage. Rather, it must take the initiative. . . .

See also *Scenic Hudson Preservation Conference v. FPC*, 354 F.2d 608, 620-21 (2d Cir. 1965), cert. denied, 384 U.S. 941

In order to determine whether an agency has lived up to these responsibilities, a reviewing court must examine the record in detail to determine that a real give and take was fostered on the key issues. This does not give the court a license to judge for itself how much weight should be given particular pieces of scientific or technical data, a task for which it is singularly ill-suited. It does require, however, that the court examine the record so that it may satisfy itself that the decision was based "on a consideration of the relevant factors."³⁵ Where only one side of a controversial issue is developed in any detail, the agency may abuse its discretion by deciding the issues on an inadequate record.

A reviewing court must assure itself not only that a diversity of informed opinion was heard, but that it was genuinely considered. "[T]he dialogue that the APA's rulemaking section contemplates cannot be a sham."³⁶ Since a reviewing court is incapable of making a penetrating analysis of highly scientific or technical subject matter on its own, it must depend on the agency's ex-

(1966) (agency duty to develop full record grounded on broad principles of administrative law); Note, *supra* note 17, 61 VAL.REV. at 891: "when the record is deficient, the Commission may even have a duty to consider issues ignored by the parties."

In both *Calvert Cliffs* and *Scenic Hudson*, the court pointed out that poorly-financed public interest intervenors may lack the wherewithal to marshal technical evidence and bring it to the Commission's attention. See also *American Public Power Ass'n v. FPC*, 522 F.2d 142, 147 (D.C.Cir. 1975) (Bazelon, C.J., concurring); *Citizens for Safe Power v. NRC*, 524 F.2d 1291, 1304 (D.C.Cir. 1975) (Bazelon, C.J., concurring).

³⁵ *Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 416 (1971). Cf. *Ethyl Corp. v. EPA*, *supra* note 30 (Bazelon, C.J., concurring), slip op., 2 n.7.

³⁶ *Wright*, *supra* note 23, 26 ADMIN.L.REV. at 206.

pertise, as reflected in the statement of basis and purpose, to organize the record, to distill the major issues which were ventilated and to articulate its reasoning with regard to each of them.³⁷

An agency need not respond to frivolous or repetitive comment it receives. However, where apparently significant information has been brought to its attention, or substantial issues of policy or gaps in its reasoning raised, the statement of basis and purpose must indicate why the agency decided the criticisms were invalid.³⁸ Boilerplate generalities brushing aside detailed criticism on the basis of agency "judgment" or "expertise" avail nothing; what is required is a reasoned response, in which the agency points to particulars in the record which, when coupled with its reservoir of expertise, support its resolution of the controversy.³⁹ An agency may abuse its discretion by proceeding to a decision which the record before it will not sustain, in the sense that it raises fundamental questions for which the agency has adduced no reasoned answers.

(B.)

With these observations in mind, we turn to our examination of this record. The significance of Table S-3 is that it expresses in numerical terms the conclusion that the environmental effects of the fuel cycle, including waste

³⁷ See *Portland Cement Ass'n v. Ruckelshaus*, 486 F.2d 375, 393-95 (D.C.Cir. 1973), *cert. denied*, 417 U.S. 921 (1974); cf. *Automotive Parts & Accessories Ass'n v. Boyd*, 407 F.2d 330, 338 (D.C.Cir. 1968) (statement of basis and purpose must be explicit enough to allow court "to see what major issues of policy were ventilated by the informal proceedings and why the agency reacted to them as it did").

³⁸ *Portland Cement Ass'n v. Ruckelshaus*, *supra* note 37, 486 F.2d at 393-94.

³⁹ See *Wright*, *supra* note 23, 26 ADMIN.L.REV. at 209-210.

disposal, are insubstantial.⁴⁰ The primary basis for these judgments is the data assembled by the staff in the draft Environmental Survey made public with the proposed rule. The conclusions reached by the staff in the Environmental Survey were in turn adopted without modification by the Commission as Table S-3 and embodied in the final rule. Thus, support for a rule limiting consideration of environmental issues to the numbers in Table S-3 must be found in one of three places: the Environmental Survey, the back-up documentation to which it refers, and the oral and written testimony offered at the hearing. It is to these sources we must look for a thorough ventilation of the underlying issues.

The Environmental Survey made public prior to the hearing was intended to "provide[] a basis for an informed consideration of the . . . environmental impact associated with the uranium fuel cycle . . . [and to] contain[] extensive references to background documents available to members of the public." 38 Fed.Reg. 49 (Jan. 3, 1973). Regarding most phases of the fuel cycle, these promises were fulfilled and the Environmental Survey did an adequate, even admirable job, of describing the processes involved. It assembles data on the consumption of resources, and discusses the risks of accidents and other hazards in detail, supporting the staff's conclusions with numerous references to the scholarly literature and to technical reports on file with the Commission. However, with regard to the two phases of the fuel cycle which are the focal points for this appeal, reprocessing and waste disposal,⁴¹ that kind of detailed explanation

⁴⁰ See *supra* note 19.

⁴¹ In a general way, "reprocessing" is that phase of the fuel cycle in which reusable portions of spent fuel are extracted for recycling and the remaining radioactive residues are concentrated. "Waste disposal," a misnomer for what is more appropriately termed "waste storage and manage-

and support for the staff's conclusions was noticeably absent from the Environmental Survey as originally published.

The only discussion of high-level waste disposal techniques was supplied by a 20-page statement by Dr. Frank K. Pittman, Director of the AEC's Division of Waste Management and Transportation. This statement, delivered during the oral hearings, was then incorporated, often verbatim, into the revised version of the Environmental Survey published after the comment period.⁴² Dr. Pittman began his statement by acknowledging that he was "broadly involved" with the subject of high-level waste management since he heads the division of the AEC charged with "responsibility for the development, construction and operation of facilities for ultimate management of commercial high-level waste."⁴³

Dr. Pittman proceeded to describe for the first time in public the "design concepts" for a federal surface reposi-

ment," refers to containment of wastes during the long periods necessary for them to decay naturally into non-toxic substances. See *supra* note 3.

⁴² See "Environmental Survey of the Uranium Fuel Cycle" (April, 1974) (hereafter "Revised Environmental Survey") G-23 n.18, II-J.A. 740.

For example, the discussion of the possibility of accidental release of wastes as a result of loss of coolant at *id.*, G-19-21, II-J.A. 736-737, is taken verbatim from Dr. Pittman's statement.

⁴³ II-J.A. 59. In *Portland Cement Ass'n v. Ruckelshaus*, *supra* note 37, 486 F.2d at 400 n.95, the court pointed out that where a "principal source of reliance by the agency" was "peculiarly subject to considerations of self-interest, more might be required than mere comments." Evaluation of a program by the in-house staff member charged with the responsibility for administering it falls within the intentment of that statement.

tory for retrieveable storage of high-level waste." This is essentially a warehouse in which sealed canisters containing cylinders of solidified nuclear wastes can be stored in water-filled basins recessed into the ground on a temporary basis (up to 100 years), until such time as a permanent waste disposal scheme is devised, when they can be removed." While the "intended life" of the facility is only 100 years, some high-level wastes must be isolated for up to 250,000 years. *See supra* p. 7. Therefore, the Environmental Survey states, without further explanation, that in the future a "permanent" Federal repository for "geologic storage of high-level wastes" will be established and that the "Federal government will have the obligation to maintain control over the site *in perpetuity*." II-J.A. 724 [emphasis added].

Until recently the AEC planned to dispose of wastes by burying them deep inside abandoned salt mines. These plans were postponed indefinitely after a series of tech-

"The staff subsequently described the significance of Dr. Pittman's testimony as follows:

When the [Environmental Survey] was published in November 1972, the data on the proposed Federal Repository for high level waste storage were limited to preliminary criteria and generalized statements. . . . The information in Dr. Pittman's statement is the first public release of the preliminary concepts for the Federal Repository and provides a summary of the current status and potential environmental effects of the high level waste interim storage facility and further AEC plans for longer term storage. The information from his testimony will be incorporated in the revised edition of the [Environmental Survey]. . . . The additional data presented by Dr. Pittman show that the interim high-level waste repository will be designed to have little environmental impact.

"Additional Information on Environmental Effects of the Uranium Fuel Cycle," II-J.A. 355-56.

"See Revised Environmental Survey, G-7, II-J.A. 724.

nical difficulties, including the discovery the salt mines might be susceptible to underground flooding. The Revised Environmental Survey devotes two sentences to recounting how prior waste disposal plans fared:

It was planned to construct a Federal repository in a salt mine for long-term geological storage of solid high-level wastes by the mid 1970's. However, subsequent events have deferred the site selection and construction of such a facility.

II-J.A. 724. The "subsequent events" which led to the shelving of the salt mine plan are not discussed."

"The difficulties encountered regarding the primary site considered, salt beds near Lyons, Kansas, have recently been summarized as follows:

Although that site had been under consideration for many years by the [AEC], it was not until 1971 that the commission and its contractors discovered two major problems with it. One was a series of abandoned gas and oil drill holes in the area. Another was an adjacent salt mine's extensive use of water to dissolve out the salt—including a hydraulic fracturing technique which had resulted in the disappearance underground of some 175,000 gallons of water. Both discoveries cast doubt on the long-term safety and integrity of the proposed Lyons site, since it appeared possible that water might penetrate the area and allow radioactive wastes to escape.

Boffey, "Radioactive Waste Site Search Gets Into Deep Water," 190 SCIENCE 361 (Oct. 24, 1975).

After the planned site near Lyons, Kansas was abandoned, attention focused on salt beds in southeastern New Mexico. Unexpected problems have recently been encountered at this site, too. A test hole hit a large underground pocket of brine and explosive gases. Not only would the presence of these gases threaten the safety of workers at any facility, but a "second disturbing aspect is that the presence of the brine solution may indicate that fluids have been migrating underground, thereby threatening the integrity of the site." *Id.* As the result, the search for a suitable site has been moved once again, this time to an area several miles away.

Dr. Pittman's description of the new plan—now also postponed indefinitely “—to build a surface storage facility can only fairly be described as vague, but glowing. He begins:

... I hope I will be able to allay what I feel are unwarranted fears . . . and show that the bugaboo of waste management cannot logically be used as a rationale for delays in the progress of an essential technology for meeting our growing power demands.

* * *

[T]here are available today proven methods for managing the high-level waste from the nuclear industry in a way which will assure first that man will not be adversely affected by the radioactivity either by external or internal contact with the waste itself or by exposure to the penetrating radiation which it generates, and second that the environment [sic] effects will be very small.

II-J.A. 59-60. In less than two pages, he set out a very general description of what the facility is supposed to do, II-J.A. 63-66, accompanied by several schematic draw-

“By letter dated April 9, 1975, the Administrator of ERDA informed the Congressional Joint Committee on Atomic Energy that preliminary funding for a Retrievable Surface Storage Facility was being deleted from the fiscal 1976 budget request pending a “comprehensive reevaluation of the federal program in this critical and controversial area.” See “ERDA Shelves a Nuclear Waste Storage Plan,” 188 SCIENCE 345 (April 25, 1975).

As part of that review, we understand revised impact statements are being prepared concerning reprocessing and waste disposal. As those matters are not before us, we intimate no opinion regarding the extent to which they may cure the deficiencies in the present proceeding.

Recent Congressional testimony by ERDA officials indicates a return to the plan to bury wastes, although no site has been finally chosen. “Salt, Rock Formations Favored for A-Wastes,” *Washington Post*, May 11, 1976, A-2, cols. 1-3.

ings. These show the facility will have a cooling system, a transfer area and storage basins, but do not attempt to describe how they will be built and operated, what materials will be used, where such a facility might be located, or what it might cost to build and operate.

Dr. Pittman then explains that “the major factor in the design of the repository for high-level waste is the technique used to remove the heat from the waste.” II-J.A. 63. Decaying radioactive waste spontaneously gives off substantial heat and “[s]hould adequate provisions not be made to remove this heat . . . , the waste and the canister would melt.” *Id.* A “meltdown” would result in what Dr. Pittman calls a “situation of considerable concern,” which would involve the “loss of some fraction of the isolation of the radioactive material from the environment.” II-J.A. 65. No attempt is made to describe how serious a radioactivity hazard would be presented.

In a paragraph which is carried over verbatim in the Revised Environmental Survey, II-J.A. 726, Pittman states:

The Commission has carried out extensive evaluations of safety, reliability, operability, maintainability and economics of various methods for removing heat, and has essentially narrowed the area for further study to techniques using either water or air as the heat transfer medium.

II-J.A. 64. No citations are given for these studies; in fact, there are no references to back-up materials supporting any of Pittman's statement, or those portions of the Revised Environmental Survey drawn from it.”

“Following Dr. Pittman's presentation one of the presiding board members remarked:

... one of the, I think, outstanding practices of the Staff has been in the past, at least as far as I can tell,

Again without benefit of details, Dr. Pittman offers conclusory reassurances that the proposed facility will be designed so that the possibility of a "meltdown" can be dismissed as "incredible":

The probability of this situation occurring is prevented by a combination of engineered features including, (i) redundancy of power supply and other essential cooling systems; (ii) structural strength to withstand credible forces of nature—earthquake, tornado, etc.; (iii) combination of structural strength, plant security, etc., to withstand credible overt forces of man; (iv) modular basin cell construction which limits the number of canisters subject to a single catastrophic event.

to meticulously document the assumptions that are made in the discussions. I find that that has not been done here. . . . I guess I must assume that one of the reasons that those assumptions have not been documented and clarified or justified in the purest sense of the word, is because of the time schedule required to get this thing on so we could get to hearings. Can it be assumed that if there is going to be a significant revision to this document that in those areas where assumptions are made, particularly where there is a statement to the effect that something is trivial, or insignificant, that somewhere there will appear in that same document some kind of justification based on data or a reference which one can go back to and find the source.

II-J.A. 116-17.

A staff member assured the questioner "[w]e will make every effort to go back and see if we can improve that," II-J.A. 118, and subsequently the staff submitted a 56 page document of "Additional Information on Environmental Effects of the Uranium Fuel Cycle," II-J.A. 352. However, less than two pages are devoted to the waste disposal issues addressed by Dr. Pittman, and these merely correct four minor numerical and typographical errors or omissions in his testimony. See II-J.A. 402-03. Nor does the Revised Environmental Survey fill in the gaps in Dr. Pittman's testimony.

Thus, before a meltdown could occur, it would be necessary to have a series of failures of systems which will be engineered, constructed, and operated for maximum reliability under rigorous quality assurance programs before a situation could occur where sufficient water could not be added to and maintained in the cell to keep it from leaking or boiling dry. The timing for such a series of failures to result in uncorrectable situations is important. The individual failure of power systems for circulating the coolant would not result in pool water boiling for at least 16 hours. Various corrective actions may be taken any time within a week which would prevent cell water from boiling away. After the complete loss of water, an additional day would be required before the waste would begin to melt. The number of sequential failures required of highly reliable systems, combined with the long time periods available for repair and recovery from each, result in the judgment that this is an incredible incident.

II-J.A. 65-66. His unadorned conclusion is in turn incorporated verbatim into the Revised Environmental Survey."

Other than the broad reference to "structural strength, plant security, etc., to withstand credible overt forces of man", there is no discussion of how the facility would be protected from terrorism." While Dr. Pittman says

"See "Environmental Survey of the Uranium Fuel Cycle" (April, 1974) G-19-20, II-J.A. 736-737.

"When Dr. Henry Kendall, an expert witness for Consolidated National Intervenor, tried to raise the risks of terrorism, he met the following reception from the chairman of the hearing board:

I have just one question . . . with regard to nuclear blackmail and the potential terrorist activities. What I am a little puzzled about is its relevance I say this with all due respect, Dr. Kendall; I guess those words are

"[v]arious corrective actions" might be taken to prevent a meltdown, none are specified.

Dr. Pittman concludes with the judgments that:

... (1) the program being followed by the industry under AEC regulation and by the AEC offers assurance that the commercial high-level waste will be managed safely from its initial production; (2) the surface storage method, to be used by the AEC, is good for as long as adequate human surveillance and maintenance effort is continued; (3) the probability that work currently under way will demonstrate the use of bedded salt as a safe, acceptable, ultimate disposal method within the next ten to fifteen years is very high; (4) should bedded salt not prove to be acceptable, other acceptable geologic

exciting reading in the newspapers, but I would like to have [you] indicate the relevance between the responsibilities of the Atomic Energy Commission under the National Environmental Protection Act [sic] in these respects as against, at least, what I read to be the subject matter of your comments in this particular wise, and that is the military and potential security aspects of the transportation of nuclear materials. Do I make myself clear?

An attorney for the intervenors then explained that NEPA requires consideration of more than the "simplistic questions" of "how many fish will get hurt. . . ." The chairman responded:

You see then, forgive me for using the word, a fusion somehow between what is known as, I understand, the impact on the environment as against the political and military security?

[Attorney]:

Of course, what is precisely involved in political and military security is that someone threatens to do a heck of a lot of damage to the environment in exchange for something they want.

II-J.A. 213-16.

disposal concepts offer reasonable probability of reaching a point of acceptability within two or three decades; and (5) the waste in initial storage will be easily retrievable for either near- or far-term disposal methods when they are developed.

II-J.A. 82. There is no discussion of how "adequate human surveillance and maintenance" can be assured for the periods involved, nor what the long-term costs of such a commitment are, nor of the dangers if surveillance is not maintained.⁵¹ Nor is any explanation offered for Dr. Pittman's optimism regarding bedded salt as a disposal method, since the problems which have surfaced and delayed that program are not mentioned.⁵² Nor does the statement anywhere describe what "other

⁵¹ A subsequent report to the Administrator of ERDA by a four-man task force, including Dr. Pittman, reflects a much less rosy assessment of the problems of reprocessing and waste disposal. NUCLEAR FUEL CYCLE: A REPORT OF THE FUEL CYCLE TASK FORCE, ERDA-83 (March, 1975).

The unanimous task force concluded, *inter alia*, "there are still many technical problems and uncertainties in the overall area of processing of spent fuel and properly managing its radioactive waste", *id.*, 40; "[t]he costs of storage and ultimate disposal . . . are very much higher than had previously been assumed . . .", *id.*, 46; "[the public] fear[s] that the radioactive waste generated . . . will either be neglected, and thus place an unacceptable hazard potential on mankind, or be managed in a way that will place an unacceptable burden on future generations to assure continued public safety. [T]hese . . . fears . . . are supported by a fair segment of the scientific community—many of whom otherwise support the use of nuclear reactors for generation of electric power", *id.*, 49-50.

⁵² See *supra* note 46. Contrary to Dr. Pittman's unexplained optimism, an article in SCIENCE recently termed finding a site for long-term disposal of radioactive wastes "one of the key unresolved problems of the nuclear era." Roffey, *supra* note 46, 190 SCIENCE 361 (Oct. 24, 1975).

acceptable geologic disposal concepts" are under consideration.

When Dr. Pittman finished, no questions were put to him by the hearing board.⁵³ No cross-examination was permitted.

Based on Dr. Pittman's statement, the Revised Environmental Survey concludes that the resources consumed in waste storage will be minimal, that "under normal conditions" no radioactivity will be released, and that the possibility of a serious accident is "incredible."⁵⁴ In short, based on the information in Dr. Pittman's statement, the Commission concluded that the future environmental effects from the disposal of high-level nuclear wastes are negligible. This conclusion is in turn embodied in Table S-3, and further consideration of the issue terminated.

We do not dispute these conclusions. We may not uphold them, however, lacking a thorough explanation and a meaningful opportunity to challenge the judgments underlying them. Our duty is to insure that the reasoning on which such judgments depend, and the data supporting them, are spread out in detail on the public record. Society must depend largely on oversight by the technically-trained members of the agency and the scientific community at large to monitor technical decisions. The problem with the conclusory quality of Dr. Pitt-

⁵³ One short comment was made concerning commercial disposal of low-level waste, II-J.A. 115, as was the observation, quoted *supra* note 48, regarding failure to provide back-up documentation.

The board's quiescence regarding Dr. Pittman is in marked contrast to its often hostile questioning of expert witnesses for the intervenors. See, e.g., *supra* note 50.

⁵⁴ Revised Environmental Survey, *supra* note 42, G-2-G-3, II-J.A. 719-720.

man's statement—and the complete absence of any probing of its underlying basis—is that it frustrates oversight by anyone: Commission, intervenors, court, legislature or public. Given the opportunity, Dr. Pittman might have provided convincing answers to many of the questions which his statement leaves untouched. Since that did not occur, however, his judgments must either be accepted at face value, or rejected out of hand.

Although the vagueness of the presentation regarding waste disposal made detailed criticism of its specifics impossible, see II-J.A. 257, the public interest intervenors did offer a number of more general comments concerning the Commission's approach. They criticized the Commission for a general "failure to distinguish between design objectives on the one hand and performance on the other," II-J.A. 124, noting that no consideration had been given actual experience with storage of wastes generated by weapons production. II-J.A. 272-74. They also questioned confident assertions by the AEC that long-term waste management is feasible, laying particular stress on the immense time periods involved which mock human institutions:

Except for the storage of liquid wastes in tanks, for which experience from weapons production applies, all proposals for long term storage or disposal of high level waste from the nuclear power industry lie at the research and development stage.

. . . .

The impression is inescapable, in view of the present imprecise state of affairs, that no convincing statements exist regarding the long term environmental impact attending the storage and/or disposal of wastes from fuel reprocessing.

. . . .

The times during which radioactive wastes must remain secure from the biosphere have no parallel

in human affairs. Eight hundred years are required for fission products alone and millions of years if the fission products continue to be contaminated with transuranic elements at present levels. Fission technology requires that man issue guarantees on events far into the future, and it is not clear in most cases how this can be done. Institutional arrangements do not exist and never have existed to guarantee the monitoring of or attendance upon storage facilities over a millennium. In the range of a million years, serious geological uncertainties arise and even the survival of man may be doubtful. "In perpetuity" has little real meaning in human affairs.

II-J.A. 261-2. They reiterated repeatedly that the problems involved are not merely technical, but involve basic philosophical issues concerning man's ability to make commitments which will require stable social structures for unprecedented periods."

The intervenors pointed out that storing wastes above-ground places a premium on stable human institutions for monitoring and surveillance, II-J.A. 275-76; that until plans for long-term disposal in the salt beds at Lyons, Kansas fell through, *see supra* note 46, the agency had itself rejected the idea of surface storage because of the surveillance problems. II-J.A. 210-11, 287-89.

After reviewing the record, the presiding hearing board isolated several areas of controversy which it felt ought to be addressed by the Commission in issuing the proposed rule. Included were the adequacy of the discus-

" II-J.A. 275-76. An illuminating perspective is provided in D. Farney, *Ominous Problem: What to Do with Radioactive Waste*, 5 SMITHSONIAN MAG. 20, — (1974):

The entire recorded history of mankind is but a fraction of the 250,000-year storage time of plutonium. Neanderthal man appeared only about 75,000 years ago.

sion of waste disposal systems," and the need for fuller background documentation. II-J.A. 498.

The Commission disposed of these issues summarily in its statement of basis and purpose accompanying the promulgation of the rule without attempting to articulate responses to any of the points which had been raised regarding waste disposal:

Considerable information was presented at the hearing on high level waste storage utilizing a retrievable surface storage facility. A description was given of such facility, the normal radiological effluents, and a maximum credible accident.

* * *

While such a waste storage facility has not been constructed, preliminary conceptual designs have been developed using existing technology based on well established data and techniques.

" The presiding board wrote:

At the time the Environmental Survey was issued for public comment in the Rulemaking Proceeding, together with the proposed amendments to the Rules, the Survey did not contain data with regard to proposed waste disposal systems. During the course of the oral presentation, the Regulatory Staff offered for the record an extensive presentation by Dr. Frank Pittman regarding various methods for waste disposal which were in the planning stage, and, based upon such planning, assigned various values regarding assumed environmental impact of such waste storage facilities. It was argued that, in all other respects, the Survey dealt with the environmental impact of actual and existing facilities; but that, with respect to waste disposal, the Survey was unreliable in that it dealt with non-existent facilities;

II-J.A. 490.

While this is not an entirely accurate synopsis of the intervenor's position as set out above, it focused the Commission's attention on this aspect of the proceedings.

The Commission believes that the Survey and hearing record provide an adequate data base for the regulation adopted.

39 Fed.Reg. 14189 (April 22, 1974); II-J.A. 507.1 [un-numbered page following 507].⁵⁷ Thus, to the limited extent that any give-and-take was fostered on the nuclear waste issues, the Commission, in its final decision, failed to address major contentions that were raised.

(C.)

In substantial part, the materials uncritically relied on by the Commission in promulgating this rule consist of extremely vague assurances by agency personnel that problems as yet unsolved will be solved. That is an insufficient record to sustain a rule limiting consideration of the environmental effects of nuclear waste disposal to the numerical values in Table S-3. To the extent that uncertainties necessarily underlie predictions of this importance on the frontiers of science and technology, there is a concomitant necessity to confront and explore fully the depth and consequences of

⁵⁷ We note that the Commission also promised to undertake "a more definitive assessment" of the environmental effects of waste storage as more information becomes available through subsequent environmental impact statements. 39 Fed. Reg. 14190 (April 22, 1974); II-J.A. 508.

While that is praiseworthy as an acknowledgment of the Commission's responsibility to reassess its actions in the light of later information, it cannot be used as a bootstrap to excuse the present rule cutting off further consideration in licensing proceedings.

We have already held in *Vermont Yankee*, *supra* p. 8, that the Commission may not refuse to consider the environmental effects of waste disposal when it licenses an individual reactor simply by promising to consider them later when it licenses facilities for waste disposal. We see no reason why that principle applies with any less force to accomplishing the same result through rulemaking.

such uncertainties. Not only were the generalities relied on in this case not subject to rigorous probing—in any form—but when apparently substantial criticisms were brought to the Commission's attention, it simply ignored them, or brushed them aside without answer. Without a thorough exploration of the problems involved in waste disposal, including past mistakes, and a forthright assessment of the uncertainties and differences in expert opinion, this type of agency action cannot pass muster as reasoned decisionmaking.⁵⁸

⁵⁸ We reject the contention that Table S-3 is itself a "major Federal action" requiring an environmental impact statement. The Commission characterized this rulemaking as merely addressing "a procedural question involving the implementation of NEPA" 39 Fed.Reg. 14188. *Cf. Gage v. AEC*, 479 F.2d 1214, 1222 n.26 (D.C.Cir. 1973). Petitioners, however, claim Table S-3 has "substantive" effect, since it establishes values for environmental effects on which subsequent licensing decisions may turn. Reply brief at 12. While we agree that Table S-3 may have important decisional consequences by implying that fuel cycle problems are manageable, in the circumstances presented here, we do not believe these implications ripen into a proposal for agency action until they are incorporated into individual licensing decisions. *Compare Aberdeen & Rockfish R.C. v. SCRAP*, 422 U.S. 289, 320 (1975) *with* *SIPI*, *supra* note 11, and *Sierra Club v. Morton*, 514 F.2d 856 (D.C.Cir. 1975), *rev'd sub nom. Kleppe v. Sierra Club*, 44 U.S.L.W. 5104 (U.S., June 28, 1976). At that point an impact statement will be prepared with regard to the licensing decision. We do not read the statute as requiring more.

Petitioners also argue that Table S-3 violates NEPA because it is incomprehensible to "non-technical minds." *Environmental Defense Fund v. Corp of Engineers*, 343 F.Supp. 916, 933 (W.D. Miss.), *aff'd.*, 492 F.2d 1123 (5th Cir. 1972). We do not reach that issue. The defects, if any, may be cured by fuller explanation in a revised statement of basis and purpose, or in subsequent NEPA statements incorporating Table S-3.

[Continued]

Many procedural devices for creating a genuine dialogue on these issues were available to the agency—including informal conferences between intervenors and staff, document discovery, interrogatories, technical advisory committees comprised of outside experts with differing perspectives, limited cross-examination, funding independent research by intervenors, detailed annotation of technical reports, surveys of existing literature, memoranda explaining methodology. We do not presume to intrude on the agency's province by dictating to it which, if any, of these devices it must adopt to flesh out the record. It may be that no combination of the procedures mentioned above will prove adequate, and the agency will be required to develop new procedures to accomplish the innovative task of implementing NEPA through rule-making. On the other hand, the procedures the agency adopted in this case, if administered in a more sensitive, deliberate manner, might suffice.⁵⁰ Whatever techniques

⁵⁰ [Continued]

Finally, we reject the related argument that plenary consideration of alternatives was necessary in this proceeding. We agree with the Commission that this may be deferred until action is proposed to license particular disposal facilities. For purposes of this proceeding, provided a sufficiently conservative and credible assessment of a particular waste disposal method is used, it is not material that another method might turn out to be even more desirable. *See supra* note 13. Of course, we do not exclude the possibility that limited consideration of certain alternatives (*e.g.*, the consequences of not proceeding at all) may be necessary to meaningful judgments in a proceeding such as the present.

⁵¹ Agencies are always free to adopt "hybrid procedures" beyond the minima prescribed by 5 U.S.C. § 553, and commonly do. *United States v. Florida East Coast Ry.*, 410 U.S. 224, 236 n.10 (1973). In this case, the Commission elected to provide certain hybrid procedures in addition to those required by § 553—oral hearings and questioning by a presiding board. By listing other techniques, *supra* p. 39, which might aid the Commission in compiling an adequate record, we do not intimate that it must adopt any of them. What is of

the Commission adopts, before it promulgates a rule limiting further consideration of waste disposal and reprocessing issues, it must in one way or another generate a record in which the factual issues are fully developed.

Our colleague, concurring specially, expresses the view that there is "little to be gained other than delay" by remanding for additional proceedings, since it is "almost inevitable" that the Commission will reach the same result "after fully considering the problems and alternative methods of waste disposal."⁵² Even if true, that would only supply an additional reason to require the Commission to acknowledge the risks and problems, as well as lay bare its own reasoning. Agencies are less likely

concern to us is that the record after remand disclose a thorough ventilation of the issues.

On paper, the procedures used to supplement § 553 here were virtually identical to those approved by the court in *International Harvester v. Ruckelshaus*, *supra* note 23, 478 F.2d at 631, in which oral statements were allowed and the hearing board was authorized to ask questions submitted by the parties. However, in practice the procedures were administered quite differently in *International Harvester*: "[T]he hearing officers did not propound the pre-submitted questions like robots; they were charged with conducting a hearing for the purpose of focusing information needed for decision and they quite appropriately 'followed up' on questions." *Id.* In this case the board members asked no questions whatsoever of Dr. Pittman. *See supra* note 53.

⁵² Concur at 5. According to Judge Tamm, on remand "the Commission may or may not adopt one of the majority's [procedural] suggestions, but will in any case seek to comply by mechanically generating more 'negative' information respecting current problems with disposal of high level radioactive wastes and then will 'overcome' this information with citations to favorable studies and articles." *Id.*, 4.

Stripped of rhetoric, this means that the Commission may reach the same result on an adequate record—which, of course, is why we remand rather than reverse.

to persist in the face of information publicly exposing the fallacies, if any, in their position. In any event, NEPA does not guarantee a particular outcome on the merits; rather, the statute mandates only a "careful and informed decisionmaking process" to enlighten the decisionmaker and the public.⁶¹ In the rulemaking context, that requires the Commission to identify and address information contrary to its own position, to articulate its reasoning and to specify the evidence on which it relies.⁶² The Commission may well reach the same conclusion on remand. But if it does so on such a record, the Congress, the courts, and the public will all know where we stand.

* * *

⁶¹ See *Calvert Cliffs' Coordinating Comm. v. AEC*, *supra* note 14, 449 F.2d at 1115. See also, *Comm. for Nuclear Responsibility, Inc. v. Seaborg*, *supra*, 463 F.2d at 787; *NRDC v. Morton*, *supra* note 15, 458 F.2d at 833.

⁶² Evidently Judge Tamm would permit Dr. Pittman to supplement his testimony without giving those who disagree an opportunity to criticize or comment on the new material (*e.g.*, "without reopening the oral proceeding," Concur at 3). We would not agree.

Unlike explanation of the *Commission's* rationale, Dr. Pittman's testimony is part of the evidentiary support underlying the proposed rule. Cf. Concur at 7. Both rudimentary procedural fairness and § 553 require that the evidentiary "basis" for a proposed rule be subject to public scrutiny and comment. See *Portland Cement Ass'n v. Ruckelshaus*, *supra* note 37, 486 F.2d at 393 n.67; *Mobil Oil Corp. v. FPC*, *supra* note 23, 483 F.2d at 1251 n.39. This variant of the traditional adversary process permits other experts, and the public, to bring to bear the purifying effect of their comments.

At least where the existing record is inadequate to sustain a rule, an agency cannot buttress its case with additional data not subject to public comment. "If a particular rule rests on an extensive analysis of data or a complex prediction . . . the agency should not rely on any research methods or data which were not presented to the interested parties for comment or criticism." Wright, *supra* note 23, 59 CORNELL L.REV. at 383, n.34 (1974).

It has become a commonplace among proponents of nuclear power to lament public ignorance.⁶³ The public—the "guinea pigs" who will bear the consequences of either resolution of the nuclear controversy—is apprehensive. But public concern will not be quieted by proceedings like the present.

I know no safe depository of the ultimate powers of the society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion.⁶⁴

* * *

⁶³ See, *e.g.*, Remarks by USNRC Commissioner Edward A. Mason at MIT (March 4, 1976) quoted SCIENCE & GOV. RPT., 4 (April 1, 1976):

So the biggest problem impeding the contribution of nuclear power in meeting the nation's energy needs seems to me to be the lack of informed public understanding. . . .

* * *

Edward Teller, "Nuclear Salvation," NEWSWEEK (May 17, 1976) at 15:

Indeed, there is no better subject with which to scare people than nuclear energy. What is new, what is not completely understood, is always frightening. But nuclear energy is a special case. It comes from a remote part of research that, in the minds of many people, borders on science fiction. It was developed in wartime and shrouded in secrecy. It came to the attention of mankind when, in two strokes, more than 100,000 people were killed in the final days of a terrible war. . . . Can we, in our democratic society, overcome unreasonable fears?

⁶⁴ Thomas Jefferson, Letter to William Charles Jarvis (Sept. 28, 1820).

The Commission's action in cutting off consideration of waste disposal and reprocessing issues in licensing proceedings based on the cursory development of the facts which occurred in this proceeding was capricious and arbitrary. The portions of the rule pertaining to these matters are set aside and remanded."⁵

⁵ We are aware of suggestions that where agency action is based on an inadequate record, the appropriate remedy may be to remand for supplementation rather than a declaration that the rule or order is invalid. See Leventhal, *Environmental Decisionmaking and the Role of the Courts*, 122 U.P.A.L.REV. 509, 539 (1974). But cf. *Camp v. Pitts*, 411 U.S. 138, 143 (1973): If the decision of the agency "is not sustainable on the administrative record made, then the . . . decision must be vacated and the matter remanded . . . for further consideration." quoted *F.P.C. v. Transcontinental Gas Pipe Line Corp.*, *supra* note 26, 96 S.Ct. at 582 [emphasis added].

Separate Statement of Chief Judge BAZELON:

I add a word of my own on some of the broader implications of Judge Tamm's concurrence.

I agree that courts should be reluctant to impose particular procedures on an agency. For example, requiring cross-examination in a rulemaking proceeding is radical therapy, which may cause the patient to suffer a slow, painful death. "There is a not insignificant potential for havoc . . . [which is] likely to be disproportionate to the values achieved. . . ." *International Harvester Co. v. Ruckelshaus*, 478 F.2d 615, 631 (D.C.Cir. 1973). But I reject the implication that any techniques beyond rudimentary notice and comment are needless "over-formalization" of informal rulemaking. Concur at 5. Unhappily, no such bright line can be drawn between rulemaking and adjudicatory proceedings.¹

¹ The concurrence relies on Wright, *The Courts and the Rulemaking Process: The Limits of Judicial Review*, 59 CORNELL L.REV. 375 (1974), which explicitly assumes an idealized model differentiating sharply between "policy-type rules or standards, on the one hand, and proceedings designed to adjudicate particular cases on the other." *Id.*, 386. This model posits that accurately determining facts is relatively unimportant in rulemaking because the "ultimate shape of the rule seldom 'follows from the facts.'" *Id.*, 379 n.15. Based on this conceptual distinction, drawn from *Bi-Metallic Investment Co. v. State Bd. of Equalization*, 239 U.S. 441 (1915), it is argued "An adjudication is fair to the individual only if the facts are accurately found. . . . [I]n the rulemaking context, fairness is not identified with accuracy, and procedures designed to maximize accuracy at the cost of all other values are simply inappropriate." *Id.*, 379.

With all due respect, this assumes away the hybrid rulemaking problem which arises primarily when rulemaking procedures are used in contexts where accurate fact-finding is of high relative importance. See *infra* p.2 and n.3.

The purpose of rulemaking was to allow public input on policy, whereas adjudication was designed to resolve disputed facts. *See supra* note 1. However, in response to the "paralysis" of the administrative process in the last decade, rulemaking has been expanded into fact-intensive areas previously thought to require adjudicatory procedures.² Administrative proceedings are now common which do not fit neatly into either the rulemaking or adjudicatory category. These new proceedings are "hybrids" in the sense that they involve issues of general applicability which can be treated efficiently only in generic proceedings, but nonetheless involve factual components of such relative importance that a greater assurance of accuracy is required than that which accompanies notice and comment procedures.³

² *See, e.g.,* United States v. Allegheny-Ludlum Steel Corp., 406 U.S. 742 (1972); United States v. Florida East Coast Ry., 410 U.S. 224 (1973) (ratemaking).

³ The development of scientific or technical standards is a prime example. These decisions may involve both assessing scientific evidence, and also a "legislative" or policy component as to what level of risk is "safe," and how uncertainties are to be valued. *See* Handler, *A Rebuttal: The Need for a Sufficient Scientific Base for Governmental Regulation*, 43 GEO.WASH.L.REV. 808, 809 (1975).

The relative centrality of the fact-finding and policy-making components may vary depending on the precise regulatory scheme and the state of knowledge. *Compare* Ethyl Corp. v. EPA, No. 73-2205 (D.C.Cir., March 19, 1976) (en banc) (legislative policy decision) with Portland Cement Ass'n v. Ruckelshaus, 486 F.2d 375, 390-402 (D.C.Cir. 1973), cert. denied, 417 U.S. 921 (1974).

The present proceeding was devoted almost entirely to technical fact-finding. The Commission characterized its purpose as data-gathering, rather than an analysis of alternatives or costs and benefits, 39 Fed.Reg. 14188, and specifically disclaimed that the values arrived at represented "safe" operating limits. *Id.*, 14190. This was simply not, as Judge Tamm states, a proceeding to arrive at an "administrative

The need for reliable fact-finding does not necessarily imply transplanting trial-type procedures. Factual issues in hybrid proceedings tend to be complex scientific or technical ones involving mathematical or experimental data, or other "legislative facts" * peculiarly inappropriate for trial-type procedures. Agencies should innovate procedural formats responsive to the new problems created by hybrid rulemaking. Some agencies (such as FDA and EPA) have already begun to do so.⁴

Decisions in areas touching the environment or medicine affect the lives and health of all. These interests, like the First Amendment, have "always had a special claim

weighing of risks and benefits of additional reactors," Concur at 7, or to decide "whether licensing an additional reactor is worth the additional environmental risk" Concur at 5.

* *See* 2 Davis, *Administrative Law Treatise* § 15.03 (1958):

When a court or an agency finds facts concerning the immediate parties—who did what, where, when, how, and with what motive or intent—the court or agency is performing an adjudicative function, and the facts are conveniently called adjudicative facts. . . .

Stated in other terms, the adjudicative facts are those to which the law is applied in the process of adjudication. They are the facts that normally go to the jury in a jury case. They relate to the parties, their activities, their properties, their businesses. Legislative facts are the facts which help the tribunal determine the content of law and of policy and help the tribunal to exercise its judgment or discretion in determining what course of action to take. Legislative facts are ordinarily general and do not concern the immediate parties.

⁴ Judge Tamm raises the specter that the "entirely predictable" response by administrators to "procedural refinements" will be so many adjudicatory procedures that "the advantages of informal rulemaking as an administrative tool are lost in a heap of judicially imposed procedure." Concur

to judicial protection." * Consequently, more precision may be required than the less rigorous development of scientific facts which may attend notice and comment procedures.

Despite the controversy surrounding the proper standard of review in informal rulemaking cases, *see* Concur at n.2, there is less disagreement on this essential point than meets the eye. With customary perspicacity, Judge Friendly has observed that often it does not really matter much whether a court says the record is remanded because the procedures used did not develop sufficient evidence, or because the procedures were inadequate.⁷ *From*

at 6. Adjudicatory forms are no talisman which would guarantee an agency an adequate record.

Moreover, Williams, "Hybrid Rulemaking" *Under the Administrative Procedure Act: A Legal and Empirical Analysis*, 42 U.CHL.L.REV. 401 (1975), points out that the hybrid rulemaking cases have not in fact had that kind of impact on agency behavior. *Id.*, 425, 428, 448. Contrary to Judge Tamm's statement that cross-examination afforded only delay and something to be traded off for "substantative concessions," Concur at n.6, Williams actually discovered that the parties were able to agree on *procedural* innovations which better met their needs and were less time-consuming than cross-examination. *See* Majority Op., *supra* note 28.

* *Environmental Defense Fund, Inc. v. Ruckelshaus*, 439 F.2d 584, 598 (D.C.Cir. 1971) (Bazelon, C.J.). *See also* Leventhal, *Environmental Decisionmaking and the Role of the Courts*, 122 U.P.A.L.REV. 509, 512-13 (1974).

⁷ In discussing the article by Judge Wright, *supra* note 2, on which the concurrence relies, Judge Friendly writes:

A judge not in the arena must wonder whether the war Judge Wright is waging with his colleagues is not in some degree semantic. . . . One can hardly quarrel with the conclusion that if a reviewing court finds that the procedures followed by the agency in adopting a rule have not produced a body of evidence enabling it to pronounce the required benediction, the court must remand. . . . It is thus not too consequential whether a court invalidates a rule on the ground that the procedures have

the standpoint of the administrator, the point is the same: the procedures prescribed by § 553 will not automatically produce an adequate record. Thus, although Judge Tamm vehemently opposes the concept of procedural review of informal rulemaking, he agrees to send this case back for a fuller development of the facts *even though the dictates of § 553 were followed*.^{*}

Of course, important differences remain *from the standpoint of a reviewing court*. I am convinced that in highly technical areas, where judges are institutionally incompetent to weigh evidence for themselves, a focus on agency procedures will prove less intrusive, and more likely to improve the quality of decisionmaking, than judges "steeping" themselves "in technical matters to determine whether the agency has exercised a reasoned discretion." *See Ethyl Corp. v. EPA*, No. 73-2205 (D.C.Cir., March 19, 1976)

not developed substantial evidence to support it or even evidence adequate to rebut a claim that it is arbitrary and capricious, or, instead, takes the route of prescribing ad hoc procedural requirements in addition to those of section 553. . . . Both roads lead to the conclusion that an administrator engaged in rulemaking governed by the APA cannot always be sure that rudimentary notice and comment procedures, even if they measure up to Judge Wright's salutary specifications, will always suffice.

Friendly, *Some Kind of Hearing*, 123 U.P.A.L.REV. 1267, 1313-14 (1975) [footnotes omitted].

* The logic of Judge Tamm's position that the "deficiency" here is not with the procedures used to make a record, just with the "record generated," Concur at 2, totally escapes me.

Judge Tamm also criticizes the court for failing to tell the Commission "in precise terms" how to achieve a "thorough ventilation" of the factual issues. Concur at 3. He apparently finds greater specificity in an instruction to the Commission to provide "an explanation of the basis" of its conclusions. Concur at 7.

(en banc) (Bazelon, C.J., concurring), *cert. denied*, 44 U.S.L.W. 3719 (June 10, 1976).^{*}

^{*} Cf. *Lathan v. Brinegar*, 506 F.2d 677, 693 (9th Cir. 1974) (en banc):

We think that the courts will better perform their necessarily limited role in enforcing NEPA if they apply [the "without observance of procedure required by law" standard of 5 U.S.C.] § 706(2) (D) in reviewing environmental impact statements for compliance with NEPA than if they [sic] confine themselves within the straight jacket of [the "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law" standard of 5 U.S.C.] § 706(2) (A).

See also *Ohio v. Wyandotte Chem. Corp.*, 401 U.S. 493, 504 (1971) (original jurisdiction declined in pollution case involving complex, novel and technical factual questions):

... Ohio is raising factual questions that are essentially ones of first impression to the scientists. The notion that appellate judges, even with the assistance of a most competent Special Master, might appropriately undertake at this time to unravel these complexities is, to say the least, unrealistic. Nor would it suffice to impose on Ohio an unusually high standard of proof. That . . . would not lessen the complexity of the task of preparing responsibly to exercise our judgment, or the serious drain on the resources of this Court it would entail.

TAMM, *Circuit Judge, separate statement concurring in result*:

Licensing a nuclear reactor unquestionably constitutes a "major Federal action[] significantly affecting the quality of the human environment" requiring a "detailed" environmental impact statement under section 102 (2) (C) of NEPA, 42 U.S.C. § 4332(2) (C) (1970). Approval of such a facility, which inevitably will produce high level radioactive wastes, some of which must be isolated from the "biosphere" for a quarter of a million years, undeniably necessitates an "irreversible and irretrievable commitment[] of resources" within the meaning of the Act. 42 U.S.C. § 4332(2) (C) (v). A panel of this court has previously indicated that NEPA requires potential environmental problems of this magnitude to be dealt with in advance of such a substantial commitment, not ignored until new commitments inevitably follow from the old. See, e.g., *Calvert Cliffs' Coordinating Comm. v. AEC*, 449 F.2d 1109, 1128 (D.C. Cir. 1971).¹ I agree with the majority that NEPA requires the Commission fully to assure itself that safe and adequate storage methods are technologically and economically feasible. It forbids reckless decisions to mortgage the future for the present, glibly assuring critics that technological advancement can be counted upon to save us from the consequences of our decisions. I further agree with the conclusion of the majority that it is impossible to determine from the record before us whether the Commission has fulfilled its statutory obli-

¹ A major purpose of NEPA was to avoid the limiting effect of incremental decisionmaking by confronting environmental problems before foreclosing alternative methods of dealing with them. See S. Rep. No. 296, 91st Cong., 1st Sess. 5 (1969), quoted in Majority 9. To this end, NEPA requires a thorough cost-benefit study in each case before undertaking major federal action affecting the quality of the human environment. *Calvert Cliffs' Coordinating Comm. v. AEC*, *supra* at 1128.

gation under NEPA in adopting the S-3 table, in effect deciding that the incremental environmental effect of storing the waste of an additional nuclear reactor is negligible, or whether it has uncritically adopted as its own the undocumented conclusions of a single witness that the waste storage issue is a "non-problem" with which the Commission need hardly concern itself at this time. Accordingly, the inadequacy of the record demands that we remand this case to the Commission in order to ensure that it has taken a hard look at the waste storage issue. I cannot, however, without qualification, endorse the approach the majority has taken to reach this result or its suggested disposition on remand.

The majority appears to require the Commission to institute further procedures of a more adversarial nature than those customarily required for informal rulemaking by the Administrative Procedure Act, 5 U.S.C. § 553 (1970).² The Commission chose to proceed by "hybrid" rulemaking below, allowing petitioners to present oral arguments before the Commission and subjecting participants to questions, but not permitting participants to cross-examine. Majority note 59. By so proceeding the Commission exceeded the minimum procedural requirements of section 553.³ In my view, the deficiency

² The standard of review under section 553 has been the subject of considerable discussion in recent years, especially within this judicial circuit. See, e.g., the cases and articles cited in Majority note 23.

³ Section 553 imposes only three obligations on the rulemaker. First the rulemaker must give adequate and effective notice of "either the terms or substance of the proposed rule or a description of the subjects and issues involved." Secondly, he must "give interested persons an opportunity to participate . . . through submission of written data, views, or arguments with or without opportunity for oral presentation." Finally, the rulemaker must "incorporate in the rules adopted

is not with the *type* of proceeding below, but with the completeness of the record generated.⁴ More procedure will not, in this case, guarantee a better record, and a better record can be generated without reopening the oral proceeding at this time. We cannot conclude confidently from this record whether the Commission's staff considered all relevant factors, including the facts petitioners call to our attention, in reaching the figures embodied in Table S-3; nor can we conclude from Dr. Pittman's oral statements, substantially devoid of documentation, whether these figures represented conclusions drawn from more exhaustive research into the waste storage problem conducted by the head of the Commission division charged with this task. If Dr. Pittman's conclusions were so based, I believe the Commission is entitled to accept them, provided, of course, it is assured that they are reasonably objective.⁵

a concise and general statement of their basis and purpose." 5 U.S.C. § 553 (1970). See generally Verkuil, *Judicial Review of Informal Rulemaking*, 60 VA. L. REV. 185 (1974).

The "concise and general statement" required by section 553 must be sufficiently complete and detailed to enable the court to accomplish its reviewing function, assuring itself that the agency has engaged in reasoned decisionmaking, has given serious thought to alternative rulings, and has provided reasoned explanations for controversial normative and empirical determinations. In short, "the reviewing court must satisfy itself that the requisite dialogue occurred and that it was not a sham." Wright, *The Courts and the Rulemaking Process: The Limits of Judicial Review*, 59 CORNELL L. REV. 375, 381 (1974).

⁴ The majority also recognizes that the procedures utilized by the Commission might suffice "if administered in a more sensitive, deliberate manner." Majority 40.

⁵ See *Environmental Defense Fund, Inc. v. Corps of Engineers*, 470 F.2d 289 (8th Cir.), cert. denied, 412 U.S. 931 (1972), in which the Eighth Circuit Court of Appeals held that, although NEPA requires agencies to evaluate objectively

I am also troubled by two other aspects of the majority opinion. First, I am distressed because I believe the majority opinion fails to inform the Commission in precise terms what it must do in order to comply with the court's ad hoc standard of review.* The majority sends the waste storage issue back to the Commission for a "thorough ventilation." This language, of course, means very little in procedural terms. In order to aid the Commission in filling in the gaps in the record, the majority enumerates a number of procedural alternatives in varying degrees of formality, some less intrusive into agency prerogatives than others. Majority 39. Then, heeding the Supreme Court's admonition in *FPC v. Transcontinental Gas Pipe Line Corp.*, 96 S.Ct. 579 (1976) (per curiam), that we may not, except in extraordinary circumstances, specify agency procedures on remand, the majority declines to give the Commission any direction as to which procedure or combination of them, will suffice. The Commission is thus left to decide which to adopt, further confused by the majority's statement that, "It may be that no combination of the procedures mentioned above will prove adequate, and the agency will be required to develop new procedures to accomplish the innovative task of implementing NEPA through rule-making." Majority 39. Such specificity resembles a

their projects, it does not require agency officials to be subjectively impartial. In other words,

NEPA assumes as inevitable an institutional bias within an agency . . . and erects the procedural requirements of § 102 to insure that there is no way the decision-maker can fail to note the facts and understand the various arguments advanced by the plaintiffs if he carefully reviews the entire environmental impact statement.

Id. at 295 (quotation marks and citation omitted).

*Judicial imposition of procedural requirements on an ad hoc basis is criticized in Wright, *supra*.

standardized test in which there are numerous possible answers, including "all of the above," "none of the above," or "various combinations of the above." The result, I believe, is entirely predictable: the Commission may or may not adopt one of the majority's suggestions, but will in any case seek to comply by mechanically generating more "negative" information respecting current problems with disposal of high level radioactive wastes and then will "overcome" this information with citations to favorable studies and articles. Ultimately, of course, the Commission must decide which information to accept and which to reject, regardless of the type of procedure used. The majority opinion appears to recognize as much when it volunteers that, "On the other hand, the procedures the agency adopted in this case, if administered in a more sensitive, deliberate manner, might suffice." Majority 40 (citation omitted). This time, however, the decision whether licensing an additional reactor is worth the additional environmental risk would be one of policy or risk assessment and, consequently, would be reviewable only according to the customary "arbitrary, capricious" standard. *Amoco Oil Co. v. Environmental Protection Agency*, 501 F.2d 722, 741 (1974). I believe it almost inevitable that, after fully considering the problems and alternative methods of waste disposal and storage, the Commission will reach the same conclusion and therefore see little to be gained other than delay from imposing increased adversarial procedures in excess of those customarily required.'

'It has been argued that those cases in which we have granted a limited right of cross-examination on remand have afforded little relief other than delay and a tool with which to bargain for substantive concessions. Williams, "Hybrid Rulemaking" Under the Administrative Procedure Act: A Legal and Empirical Analysis, 42 U. CHI. L. REV. 401, 436-48. It would seem, therefore, that the right of cross-examination at a rulemaking proceeding frequently is better to have and be denied than to utilize.

This brings me to my second, related concern with the majority's approach. I believe the majority's insistence upon increased adversariness and procedural rigidity, uneasily combined with its non-direction toward any specific procedures, continues a distressing trend toward over-formalization of the administrative decision-making process which ultimately will impair its utility. As Judge Wright has recently noted, the administrative response to overuse of judicial imposition of such ad hoc procedural refinements is easily foreseeable. Fearing reversal, administrators will tend to over-formalize, clothing their actions "in the full wardrobe of adjudicatory procedures," until the advantages of informal rule-making as an administrative tool are lost in a heap of judicially imposed procedure. Wright, *The Courts and the Rulemaking Process: The Limits of Judicial Review*, 59 CORNELL L. REV. 375, 387-88 (1974).⁹ The majority's

⁹ A further problem with over-reliance on the hybrid rule-making approach has its roots in the hostility of some judges to all forms of substantive review of agency decisions. The line between substantive and procedural review is, of course, a hazy one. The same judges who most vehemently protest against judicial intrusions into the substance of administrative action, especially in highly technical areas, may not hesitate to require relatively more procedure of an agency when they dislike its substantive result. There is, I believe, a danger that judges will feel less restrained in requiring agencies to adopt procedures in excess of those required by the APA when review is couched in procedural, rather than substantive, terms. The preoccupation of the majority opinion in this case with the half-life of the plutonium atom and the myriad of geological and other technical difficulties one faces in attempting to safely store a highly toxic substance for a quarter of a million years demonstrates that judges cannot avoid the task of immersing themselves in difficult and often technical matters in order to evaluate administrative action and assure themselves that the agency has in fact dealt with all major issues. Because the relative environmental importance of the waste disposal issue before us is the subject of some

reliance upon the so-called "hybrid rulemaking" cases⁹ for its conclusion that the procedures prescribed by section 553 are inadequate for resolution of the complex issues involved in this case and its insistence that the Commission adopt more formal adversary procedures are, I believe, misplaced. Admittedly, there are rare cases in which "basic considerations of fairness" require procedures more adversarial than those prescribed by section 553. See Majority 14-15, quoting from Respondent's Brief at 13-14. I cannot agree, however, that this case requires us to reach this issue. Remanding an agency decision with instructions to initiate such procedures is an extraordinary judicial remedy which, I believe, should be reserved for extraordinary cases.

The appropriate remedy at this point is not to impose ad hoc procedural requirements in an attempt to raise the level of petitioners' participation, already adequate under section 553, but to remand for an explanation of the basis of Dr. Pittman's statements and of the staff's numerical conclusions,¹⁰ i.e. for the documentation which the majority finds so conspicuously lacking.¹¹ The

controversy, arguments about whether our focus here is "procedural" or "substantive" may be more semantic than determinative.

⁹ See the cases cited at note 23 of the majority opinion.

¹⁰ As the majority states, due process considerations probably mandate that petitioners be allowed to comment upon any additional information assembled by the Commission. Neither the Constitution nor the Administrative Procedure Act, however, directs the Commission to allow additional oral presentation, cross-examination, or any other procedures in addition to those required by section 553.

¹¹ The extent of the required statement of basis may vary, of course, according to the precise demands and issues of each particular case, but, "[a]t a minimum, the statement should refer to relevant submissions by interested parties and should

Commission should be able to supply the court with a statement of the methods by which its staff arrived at the figures embodied in Table S-3 and by which Dr. Pitt-

rebut or accept these submissions in an orderly fashion." Wright, *supra* at 381. This court has also distinguished between factual determinations and policy choices more peculiarly within the expertise of the administrative agency. In the former case, we commonly have insisted upon sufficient attention to the facts to enable the reviewing court to ascertain the underlying rationality of the resultant regulations. *Amoco Oil Co. v. Environmental Protection Agency*, 501 F.2d 722 (D.C. Cir.), *cert. denied*, 417 U.S. 921 (1974). In contrast,

[w]here . . . the regulations turn on choices of policy, on an assessment of risks, or on predictions dealing with matters on the frontiers of scientific knowledge, we will demand adequate reasons and explanations, but not "findings" of the sort familiar from the world of adjudication.

Id. at 741.

Often, of course, an agency ruling will encompass both factual determinations and policy choices. This is such a case. For example, the decision to treat the waste storage issue through generic rulemaking because it is common to all licensing decisions is clearly a policy determination within the agency's special expertise which we should review only for clear abuse of discretion. See *NLRB v. Bell Aerospace Co.*, 416 U.S. 267 (1974). The decision to license a particular reactor is also a policy or "assessment of risks" decision within the agency's discretion, provided it has adequately considered all underlying factual issues, including the waste storage issue, and has determined to its own satisfaction that safe methods of production and waste storage are already technologically and economically feasible. Finally, once so assured, the decision to postpone until later the question as to which of several feasible methods should be utilized is also, I believe, a policy, or risk assessment, decision.

This case, however, involves related factual determinations for which we must find support in the statement of basis required by section 553. Of particular relevance here is Table S-3, which reduces the environmental effect of licensing an additional reactor to certain numerical values and, in ef-

man concluded that the waste storage problem is already technologically and economically soluable. If it cannot, then we will have no choice but to invalidate the Commission's rule under the "arbitrary, capricious" standard; if it can, we should defer to the administrative weighing of risks and benefits of additional reactors.

fect, concludes that it is negligible. The claimed bases for the judgments expressed in numerical terms in Table S-3 are the data assembled by the staff in the draft Environmental Survey, adopted without substantial modification as Table S-3 and thus embodied in the final rule. As the majority indicates, neither the Survey itself, the back-up documentation to which it refers, nor the oral and written testimony offered at the hearing adequately supports these factual conclusions with respect to the waste disposal issue. Majority 21-22. The detailed explanation which characterizes other portions of the Environmental Survey is notably absent from this portion.

A-60

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 74-1385

NATURAL RESOURCES DEFENSE COUNCIL, INC., ET AL.,
Petitioners

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION
AND THE UNITED STATES OF AMERICA
Respondents

VERMONT YANKEE NUCLEAR POWER CORP.,
Intervenor

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC.
AND CONSOLIDATED NATIONAL INTERVENORS,
Petitioners

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION
AND UNITED STATES OF AMERICA
Respondents

BALTIMORE GAS AND ELECTRIC CO., ET AL.
Intervenors

Filed October 8, 1976

Before: Bazelon, Chief Judge; Edwards*, U.S. Circuit
Judge for the Sixth Circuit and Tamm, Circuit
Judge.

*Sitting by designation pursuant to Title 28 U.S. Code Sec-
tion 291 (a).

A-61

ORDER

Upon consideration of the motion of respondents United States Nuclear Regulatory Commission and United States of America for stay of mandate and for correction of this Court's opinion dated July 21, 1976, and of petitioners' opposition thereto, and movants having called to the attention of the Court certain portions of the transcript of the hearing on February 1, 1973, which portions were omitted from the Joint Appendix, it is

ORDERED, by the Court, that respondents' motion for correction of this Court's opinion dated July 21, 1976, is granted in part, and the opinion dated July 21, 1976 is amended as follows:

On page 34, delete lines 3-5.

On page 34, delete footnote 53 and renumber all succeeding footnotes.

On page 41, delete the following from footnote 53:
"In this case the board members asked no ques-
tions whatsoever of Dr. Pittman. See *supra* note
53."

In all other respects, respondents motion for cor-
rection is denied.

Per Curiam

ATOMIC ENERGY COMMISSION
[10 CFR Part 50]

ENVIRONMENTAL EFFECTS OF THE
URANIUM FUEL CYCLE

Notice of Proposed Rule Making

Notice is hereby given that the Atomic Energy Commission is considering possible amendments to its regulations in 10 CFR Part 50, Appendix D, "Interim Statement of General Policy and Procedure: Implementation of the National Environmental Policy Act of 1969 (Public Law 91-190)," that would specifically deal with the question of consideration of environmental effects associated with the uranium fuel cycle in the individual cost-benefit analyses for light water cooled nuclear power reactors.

The Commission's regulation implementing the National Environmental Policy Act of 1969 (NEPA) in 10 CFR Part 50, Appendix D, requires that each draft and final detailed statement prepared pursuant to section 102(2) (C) of NEPA for a nuclear power reactor contain a cost-benefit analysis which, among other things, considers and balances the adverse environmental effects and environmental, economic, technical, and other benefits of the facility. This regulation further provides that the cost-benefit analysis will, to the fullest extent practicable, quantify the various factors considered.

In several nuclear power reactor licensing proceedings it has been argued that the cost-benefit analysis for the facility that is the subject of the licensing action should include costs and benefits associated with the uranium fuel cycle, such as environmental effects of reprocessing spent fuel and disposal of wastes resulting from reprocessing. Other

factors related to the fuel cycle include those associated with uranium mining and milling, uranium hexafluoride production, isotopic enrichment, fuel fabrication, and transportation associated with the above. It has been urged that in each power reactor case the contribution of the nuclear power reactor to the environmental costs associated with the fuel cycle activity should be ascertained and considered in the cost-benefit balance.

The Commission's Atomic Safety and Licensing Appeal Board has held that environmental impact statements for nuclear power reactors should consider, among other things, environmental effects of the transportation of irradiated nuclear fuel from the facility that is the subject of the licensing action, and the transportation of low level wastes and of high level solid wastes other than irradiated fuel from the facility to depositories, but should not consider environmental effects of reprocessing of irradiated nuclear fuel, the disposal of wastes resulting from reprocessing, or disposal of low and high level solid wastes. In the matter of Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), Docket No. 50-271, Memorandum and Order, June 6, 1972. Subsequently, the Appeal Board in that case held that mining and manufacturing of reactor fuel are not within the scope of the environmental review prescribed for nuclear power reactors by NEPA and the Commission's regulations (Decision, October 11, 1972).

In connection with the foregoing, it should be noted that in conjunction with the revision of Appendix D of 10 CFR Part 50 on September 9, 1971, there was transmitted by the Director of Regulation to applicants for licenses to construct or operate nuclear power plants, and made available to the public, a document dated September 1, 1971, which, among other things, indicated that applicants' environmental reports should describe the environmental effects of

the transportation of fuel elements from the fuel fabrication plant to the reactor as well as the transportation of spent fuel elements from the reactor to the fuel reprocessing plant and the transportation of packaged radioactive material from the reactor to low level waste burial grounds.

There are in the United States well over 100 nuclear power reactors in operation, under construction, or on order, and, in addition, three commercial nuclear fuel reprocessing facilities have received operating licenses or are under construction. The existence of a uranium mine or mill, uranium hexafluoride plant, enrichment facility, fuel fabrication plant, fuel reprocessing plant, or ultimate waste depository does not depend upon the licensing of any one nuclear power reactor, nor does the cold or irradiated fuel or waste from any one reactor make more than a fractional contribution, if any, to the effects of such activities or facilities. Uranium mining and milling, uranium hexafluoride production, isotopic enrichment, and fuel fabrication will contribute fuel to many nuclear reactors and the effects associated with fuel reprocessing and waste disposal will be those associated not only with nuclear power reactors now operating or under construction, but also with those that are no longer in operation and those that are planned for the future. There does not appear to be any way to ascertain with any degree of certainty which of the uranium mines or mills, uranium hexafluoride plants, isotopic enrichment facilities, and fuel fabrication plants in existence or to be operated in the future will contribute fuel to a given nuclear power reactor, or which of the various fuel reprocessing plants or commercial burial grounds now in existence or to be constructed from time to time will receive irradiated fuel or wastes from any given nuclear power reactor.

Many of the various elements in the nuclear fuel cycle involve varying methods or processes with different en-

vironmental and other effects and there is no reason to believe that during the useful life of any given nuclear power reactor other methods or processes with different effects will not be developed. In addition, effects of uranium milling and mining, uranium hexafluoride production, fuel element fabrication, spent fuel reprocessing, operation of licensed burial grounds, and transportation incident to each of the above, are, except as those activities are subject to agreement State jurisdiction, the subject of Commission NEPA review proceedings associated with issuance of materials or facility licenses that are separate from the review proceedings for issuance of licenses for nuclear power reactors.

Cost-benefit analyses of nuclear power reactor license applications should contain a full and frank disclosure and consideration of costs and benefits of the proposed action. The results of the application of this principle to the question of inclusion of environmental effects associated with the fuel cycle are not entirely clear. As the above discussion indicates, the fractional contribution, if any, of the environmental effects of the fuel cycle to the cost-benefit balance for a particular nuclear reactor is difficult, and may be impossible, to ascertain with any degree of certainty. This suggests that such matters, if they are to be considered at all, be considered in a generic fashion through the rule making process. The Commission's regulatory staff has prepared a report entitled "Environmental Survey of the Nuclear Fuel Cycle," dated November 6, 1972, which provides a basis for an informed consideration of the generic question of the environmental impact associated with the uranium fuel cycle in light water cooled nuclear power reactor licensing proceedings.

To aid the Commission in its consideration of possible amendments to Appendix D to 10 CFR Part 50 of its regu-

lations that would deal with the question of the account to be taken of the environmental effects associated with the uranium fuel cycle in individual cost-benefit analyses for light water-cooled nuclear power reactors, interested persons are invited to submit comments and suggestions, together with relevant data and information, with respect to possible additions to 10 CFR Part 50 along the following alternative lines:

(1) In the case of light water-cooled nuclear power reactors, the applicant's environmental report and the Commission's detailed statement shall contain a full discussion of, inter alia, the environmental effects of the transportation of cold fuel to the reactor and irradiated fuel from the reactor to a fuel reprocessing plant and the transportation of low level waste and high level solid wastes (other than irradiated fuel) from the reactor to depositories. Those documents need not cover the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, disposal of low level and high level solid wastes or transportation related to such activities (other than transportation of cold fuel to, and irradiated fuel from, the reactor), since the environmental effects of those activities as related to a particular light water-cooled nuclear power reactor have been analyzed in the Commission's "Environmental Survey of the Nuclear Fuel Cycle" and, when factored into the cost-benefit analysis, are sufficiently small as not to affect significantly the resultant conclusion. The environmental effects of the latter activities will generally be considered in detail in proceedings in which approval for such activities, or closely related activities, is sought.

(2) Or in the case of light water-cooled nuclear power reactors, the applicant's environmental report and the

Commission's detailed statement shall contain a full discussion of, inter alia, the environmental effects of the transportation of cold fuel to the reactor and irradiated fuel from the reactor to a fuel reprocessing plant and the transportation of low level wastes and high level solid wastes (other than irradiated fuel) from the reactor to depositories. In such documents, the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation and disposal of wastes resulting from such reprocessing, disposal of low level and high level solid wastes and transportation related to such activities (other than transportation of cold fuel to, and irradiated fuel from, the reactor) to the environmental costs of licensing the nuclear power reactor, shall be as set forth in the following Table S-3 of the Commission's "Environmental Survey of the Nuclear Fuel Cycle":¹

¹ The "Environmental Survey of the Nuclear Fuel Cycle" provides the supporting data for this summary table.

TABLE S-3

SUMMARY OF ENVIRONMENTAL CONSIDERATIONS
FOR NUCLEAR FUEL CYCLE
(NORMALIZED TO MODEL LWR ANNUAL FUEL REQUIREMENTS)

Natural resource use	Total	Effluents — Chemical (MT)	Total
Land (acres):		Gases (including entrainment): ¹	
Temporarily committed.....	83	SO ₂	4400
Undisturbed area.....	45	NO _x	1170
Disturbed area.....	18	Hydrocarbons.....	11.3
Permanently committed.....	4.6	CO.....	28.7
Overburden moved (MT×10 ⁻⁶).....	2.7	Particulates.....	1156
Water (gallons×10 ⁻⁶):		Other gases:	
Discharged to air.....	163	F.....	1.0
Discharged to water bodies.....	11,052	Liquids:	
Discharged to ground.....	123	SO ₂	8.8
Total.....	11,338	NO _x	8.2
Fossil fuel:		Fluoride.....	0.4
Electrical energy (mw-hr.×10 ⁻⁶).....	317	Ca ⁺⁺	5.4
Equivalent coal (MT×10 ⁻⁶).....	118	Cl ⁻	8.2
Natural gas (a.c.f.×10 ⁻⁶).....	103	Na.....	12.5
		NH ₃	8.4
		Fe.....	0.4
		Tailings solutions (×10 ⁻⁶).....	340
		Solids.....	91,000
Effluents—Radiological (curies)	Total	Maximum effect per annual fuel requirement of model 1000 MWe LWR	
Gases (including entrainment):			
Ra-222.....	83	} Principally from mills — Maximum annual dose rate < 4 percent of average natural background within 5 miles of mill. Results in 0.05 man-rem per annual fuel requirement. Due to dilute concentration and short half-life of principal component, exposure beyond a 5-mile radius is minuscule relative to natural background.	
Ra-226.....	.02		
Tb-230.....	.02		
Uranium.....	.046		
Tritium (×10 ⁻⁶).....	12		
Kr-85 (×10 ⁻⁶).....	350		
I-129.....	.002	} Principally from fuel reprocessing plants—Whole body dose is 4.4 man-rem for population within 50-mile radius. This is < 0.005 percent of average natural background dose to this population.	
I-131.....	.02		
Fission products.....	1.0		
Transuranics.....	.004		
Liquids:			
Uranium and daughters.....	2.4	} Principally from milling—included in tailings liquor and returned to ground—no effluents; therefore, no effect on environment.	
Ra-226.....	.027		
Tb-230.....	.37	} From UF ₆ production—concentration < 5 percent of 10 CFR 20 for total processing of 27.5 model LWR annual fuel requirements.	
Tb-234.....	.001		
Other uranium daughters.....	.001	} From fuel fabrication plants—concentration < 1 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.	
Ra-106.....	4		
Tritium (×10 ⁻⁶).....	6.2	} From reprocessing plants—maximum concentration < 4 percent of 10 CFR 20 for total reprocessing of 26 annual fuel requirements for model LWR.	
Solids (buried):			
Other than high level.....	1,300	} From mills—included in tailings returned to ground—no significant effluent to the environment.	
Thermal (B.t.u. ×10 ⁻⁶).....	3,370		

¹ Estimated effluents based upon combustion of equivalent coal for power generation.
² 1.5 percent from natural gas use and process.

The Commission will hold an informal rule-making hearing on possible amendments described in (1) and (2) above on February 1, 1973, at 10 a.m. The location and the presiding officer will be designated in a notice that will be published in the FEDERAL REGISTER in the near future.

Interested persons are invited to attend the hearing and present oral or written statements. Any person who intends to present views at this hearing should furnish in writing his name and the name of the organization he represents to the Secretary of the Commission by January 1, 1973. The hearing will be conducted as a legislative-type hearing. Since the hearing will be part of a rule making, rather than an adjudicatory, proceeding, the provisions of Subpart G, "Rules of General Applicability," of 10 CFR Part 2, the Commission rules of practice, will not be applicable.

Nothing herein shall be construed as affecting the continuing validity of the above-described holdings by the Appeal Board in the Vermont Yankee proceeding during the course of this rule making proceeding, and they shall continue in effect unless and until modified by promulgation of a regulation or other Commission action.

All interested persons who desire to submit written comments or suggestions in connection with the possible amendments to Appendix D of 10 CFR Part 50 or the "Environmental Survey of the Nuclear Fuel Cycle," should send them to the Secretary of the Commission, U.S. Atomic Energy Commission, Washington, D.C. 20545, Attention: Chief, Public Proceedings Staff, within sixty (60) days after publication of this notice in the FEDERAL REGISTER.

Copies of comments on this notice as well as the "Environmental Survey of the Nuclear Fuel Cycle," dated November 6, 1972, may be examined at the Commission's Public Document Room at 1717 H Street NW., Washington, DC 20545. In addition, copies of the environmental survey may be obtained upon request addressed to the Deputy Director for Fuels and Materials, Directorate of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545.

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(Sec. 161, 68 Stat. 948; sec. 102, 83 Stat. 853, 42 U.S.C. 2201, 4332)

Dated at Germantown, Md., this 10th day of November 1972.

For the Atomic Energy Commission.

PAUL C. BENDER,
Secretary of the Commission.

[FR Doc. 72-19698 Filed 11-14-72; 8:53 am]

A-71

ATOMIC ENERGY COMMISSION

[10 CFR Part 50]

[Docket RM-50-3]

**ENVIRONMENTAL EFFECTS OF THE
URANIUM FUEL CYCLE**

Notice of Hearing

On November 15, 1972, the Atomic Energy Commission published in the **FEDERAL REGISTER** (37 F.R. 24191) a notice of proposed rule making concerning possible amendments to CFR Part 50, appendix D, that would deal specifically with the environmental effects associated with the uranium fuel cycle in the individual cost-benefit analyses for light water-cooled power reactors. The notice scheduled an informal rule making hearing on the possible amendments on February 1, 1973, at 10 a.m.

The location of the hearing will be New Executive Office Building, Room G-2008, 17th and H Streets NW., Washington, D.C.

A hearing board consisting of Max D. Paglin, Esq. — Chairman, Dr. Martin J. Steindler and Dr. John C. Geyer will preside.

As stated in the November 15, 1972, notice, the hearing will be part of a rule making, rather than an adjudicatory, proceeding and the provisions of Subpart G, "Rules of General Applicability," of 10 CFR Part 2, the Commission's rules of practice, will not be applicable.

The procedural format for the hearing will follow the legislative pattern, and no discovery or cross-examination will be utilized. It should be noted, however, that the report prepared by the Commission's regulatory staff, entitled 'Environmental Survey of the Nuclear Fuel Cycle,' dated November 1972, which provides a basis for an informed

consideration of the generic question of the environmental impact associated with the uranium fuel cycle in light water-cooled nuclear power reactor licensing proceedings, is available to members of the public at the Commission's public document room at 1717 H Street NW., Washington, D.C. 20545. In addition, that report contains extensive references to background documents available to members of the public at the Commission's public document room.

The hearing will be conducted as informally and as expeditiously as practicable, consistent with affording the participants a reasonable opportunity to present their positions. Those participating in the hearing may, but need not be, represented by counsel.

Relevant written statements may be received for the record and those participating may, depending upon the number of requests received and the time available, be permitted to make brief oral statements of their views either in addition to, or in lieu of, written submissions. Persons making oral statements will not be sworn. Such persons, however, as well as persons offering written submissions at the hearing, will be subject to questioning by the presiding hearing board. All written comments and suggestions received pursuant to the invitation therefor set forth in the November 15, 1972, notice will be incorporated in the record of the proceeding.

The hearing board is authorized to take all necessary and appropriate action to control the course of the hearing, including, among other things, the holding of one or more procedural planning sessions. A transcript of the hearing will be made, and a copy of the transcript, together with copies of all documents presented at the hearing, will be placed in the Commission's public document room, 1717 H Street NW., Washington, D.C., where they will be available for inspection by members of the public.

At the conclusion of the hearing the record will be held open for a period of 30 days during which time any person may file such supplementary written statements as may be deemed appropriate in light of the hearing record. After the 30-day period expires, the presiding hearing board, without rendering any decision or making any recommendation, will forward the transcript of the hearing to the Commission together with an identification of issues raised at the hearing. The Commission will carefully consider the transcript of the hearing and the comments and suggestions submitted pursuant to the November 15, 1972, notice as well as other relevant considerations and factors, and, after reaching its determination in the rule making proceeding, will cause an appropriate notice to be published in the *FEDERAL REGISTER*.

(Sec. 161, 68 Stat. 948; sec. 102, 83 Stat. 853; 42 U.S.C. 2201, 4332)

Dated at Washington, D.C., this 27th day of December 1972.

For the Atomic Energy Commission.

PAUL C. BENDER,
Secretary of the Commission.

[FR Doc. 73-123 Filed 1-2-73; 8:45 am]

Title 10 — Energy

CHAPTER I — ATOMIC ENERGY COMMISSION
PART 50 — LICENSING OF PRODUCTION
AND UTILIZATION FACILITIES

Environmental Effects of the Uranium Fuel Cycle

On November 15, 1972, the Atomic Energy Commission published in the *FEDERAL REGISTER* a notice of consideration of possible amendments to Appendix D, Interim Statement of General Policy and Procedure: Implementation of the National Environmental Policy Act, 10 CFR Part 50, Licensing of Production and Utilization Facilities (37 FR 24191). The amendments proposed here supplement our established rules for fulfilling section 102(2)(C) procedures of NEPA. The amendments address the question whether to consider the environmental effects associated with the uranium fuel cycle in the individual cost-benefit analyses for light-water-cooled nuclear power reactors. The Atomic Safety and Licensing Appeal Board had earlier held that some such effects should be considered while others should not.¹

The proposed amendments set forth two alternative approaches to considering the environmental effects associated with the uranium fuel cycle. Under the first, such environmental effects would not have to be considered in applicants' environmental reports and Commission detailed statements of environmental considerations since, if factored into individual cost-benefit analyses, they would be sufficiently small as not to affect significantly the resultant conclusion. Under the second alternative, the environmental effect as-

¹ Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-56, ALAB-73 (June 6, 1972 and October 11, 1972).

sociated with the uranium fuel cycle, albeit small, would be factored into individual cost-benefit analyses in the form of numerical values derived from the instant proceeding. The second alternative has been adopted by the Commission as an effective rule, with certain clarifying and editorial changes. Insofar as this rule differs from the Appeal Board decisions in "Vermont Yankee" supra, those decisions have no further precedential significance. The Commission also notes that adoption of this amendment is without prejudice to consideration of whether or not a full generic environmental impact statement on the uranium fuel cycle should be issued pursuant to 10 CFR Parts 11 and 51 of the Commission's regulations.

The *FEDERAL REGISTER* notice announced the availability for comment of the "Environmental Survey of the Nuclear Fuel Cycle," dated November 1972, prepared by the Commission's Regulatory staff. This document was designed to serve as a primary data base for the proposed amendment and not as an analysis of alternatives and costs and benefits of the entire uranium fuel cycle. Indeed, certain portions of that overall fuel cycle are undergoing separate examination and are not involved in this proceeding. These include: (i) An environmental statement in support of a recommendation by the General Manager to continue the present program for developing Federal repositories for commercial high level wastes (38 FR 29350), and (ii) a separate rule making proceeding examining transportation of UO_2 fuel to and from light water reactors and transportation of solid wastes from such reactors to waste burial grounds (38 FR 3334).

In addition, another fuel cycle for light water reactors is under study by the staff. Typical programs underway on this subject include: (i) Preparation of a generic environmental impact statement concerning potential programs for

recycling plutonium in commercial light-water reactors (39 FR 5536), (ii) analysis of methods for disposal of wastes contaminated with plutonium, and (iii) an environmental analysis of the proposed amendment to 10 CFR 71 that would require significant quantities of plutonium to be shipped as a solid in packages providing at least double containment (38 FR 20482).

The survey described stages of the fuel cycle for the purpose of determining whether the cost-benefit analysis required by NEPA and our regulation (10 CFR Part 50, Appendix D) for environmental impact studies in licensing proceedings should include numbers quantifying effects of the uranium fuel cycle. The purpose of this proceeding was to make determinations as to whether certain elements should be factored into impact statements to be utilized in other proceedings; the purpose was not to undertake a full environmental review of the uranium fuel cycle. In short, this proceeding addresses a procedural question involving the implementation of NEPA's requirement for cost-benefit analyses in impact studies. For this reason, no environmental impact statement has been prepared in connection with the rule adopted today.

All interested persons were invited to submit written comments and suggestions in connection with the proposed amendments and the Environmental Survey within 60 days after publication of the notice in the *FEDERAL REGISTER*. In addition, an informal rule making hearing was held on February 1, 1973, to permit the presentation of written and oral views on the Environmental Survey and the alternative approaches to consideration of the environmental effects associated with the uranium fuel cycle.

On January 3, 1973, the Commission issued a Supplemental Notice setting forth the procedures which were to

be followed in the informal rule making hearing (38 FR 50). The notice stated, among other things, that since the hearing would be part of a rule making rather than an adjudicatory proceeding, the provisions of Subpart G, Rules of General Applicability, of Part 2 of the Commission's rules of practice would not be applicable and that, therefore, such procedural features as discovery and cross-examination would not be utilized. The notice provided, however, that the participants in the hearing would be subject to questioning by the presiding hearing board. The notice further provided that at the conclusion of the hearing, the record was to be held open for a period of 30 days during which time any person could file supplementary written comments deemed appropriate in light of the hearing record. After the expiration of the 30-day period, the presiding hearing board, without rendering any decision or making any recommendation, was to forward the hearing transcript to the Commission together with an identification of issues raised at the hearing.

Written comments were received from 46 individuals and organizations representing Federal and State agencies, industry, public utilities, environmental and citizen groups, and private citizens. Participants in the informal rule making hearing included the Commission's Regulatory staff; the Environmental Protection Agency; the Mapleton Intervenor of Midland, Michigan; Westinghouse Electric Corporation; Consolidated National Intervenor and the Union of Concerned Scientists, jointly; the Atomic Industrial Forum; the Consolidated Utilities, composed of fourteen utilities appearing jointly; the New York State Department of Environmental Conservation; and the Minnesota Pollution Control Agency. In addition, two individual members of the public made limited appearances.

In its "Report to the Commission by the Nuclear Fuel Cycle Hearing Board," submitted on July 6, 1973, pursuant

to a Supplemental Notice of Hearing published on January 3, 1973, the presiding hearing board identified a number of issues which it believed were raised at the hearing and in the written comments. The first issue identified concerned a challenge by CNL/UCS to the procedures used by the Commission for the hearing. That participant argued that for any rulemaking hearing dealing with the environmental effects of the nuclear fuel cycle on a generic basis to be legally valid, the hearing must incorporate the same adjudicatory procedural features used in individual production and utilization facility licensing proceedings, including the rights of discovery and cross-examination. On the basis of this contention, the participant recommended adoption of a "third alternative" which would provide for an "on-going generic hearing" requiring preparation and circulation of an environmental impact statement. Under this alternative, parties to individual reactor licensing proceedings would be permitted to participate in an "adjudicatory" rule making proceeding, the findings of which would be incorporated into the record of individual licensing hearings.

The Commission has considered this challenge to the legal validity of the present rule making proceeding and the arguments in opposition which were filed by other parties. In our view, the procedures adopted provide a more than adequate basis for formulation of the rule we adopted. All parties were fully heard. Nothing offered was excluded. The record does not indicate that any evidentiary material would have been received under different procedures. Nor did the proponent of the strict "adjudicatory" approach make an offer of proof — or even remotely suggest — what substantive matters it would develop under different procedures. In addition, we note that all documents including the Survey were available to the parties several weeks be-

fore the hearing, and the Regulatory staff, though not requested to do so, made available various drafts and handwritten notes.² Under all of the circumstances, we conclude that adjudicatory type procedures were not warranted here.

The second area in which issues were identified by the presiding hearing board related to the scope and depth of the underlying Environmental Survey. One issue was whether, in light of the comments in the record, substantial revision of the survey should be made prior to adoption of a final rule. Also identified was the issue of whether the Administrative Procedure Act requires reopening of the proceeding to permit comment on any revised survey and whether such reopened proceeding should be made a proceeding conducted in the manner of the original proceeding in which comment would be invited on all aspects of the nuclear fuel cycle; or whether such proceeding should be limited to comment only on the revisions to the Survey.

In discussing the issues in this area, the presiding hearing board mentioned, among other things, the factors of safeguards against sabotage and diversion of nuclear materials and plutonium handling. The board also indicated that arguments had been advanced that the Survey was unreliable with respect to high level waste disposal in that facilities for such disposal are presently non-existent.

Sabotage and diversion receive considerable attention in licensing of individual fuel cycle facilities. The issuance of any special nuclear material license involving significant quantities of such material is contingent upon a finding by the AEC that the required accountability and physical se-

² Some or all of these items might not have been provided under rigid adjudicatory rules. For example, on the one occasion when CNL/UCS requested a specific document, it was promptly made available, even though it was an internal staff memorandum written for the Commissioners themselves.

curity systems are adequate to provide reasonable protection against acts of sabotage and diversion of materials. Beyond this, insofar as environmental impact is concerned, sabotage and diversion may be viewed in the context of possible contributing factors, among others, to accident conditions. The Environmental Survey does, in fact, consider a number of postulated accidents and their environmental effects. The postulated accidents thus considered in the Survey are deemed to be a reasonable representation of the environmental effects that could result from the more credible acts of sabotage.

Those aspects of the uranium fuel cycle which involve plutonium handling, namely recovery and storage, were described in the Environmental Survey. However, other forms of plutonium handling were not discussed in the survey because the survey is applicable only to light-water-power reactors using conventional uranium dioxide fuel. Reactors utilizing plutonium recycle fuel fall outside the Survey's scope of coverage and, therefore, the values in the Summary Table are inapplicable. As stated earlier, however, the Commission is presently drafting an environmental impact statement covering all aspects of the full-scale use of plutonium in light-water reactors, including the fuel cycle.

Considerable information was presented at the hearing on high level waste storage, utilizing a retrievable surface storage facility. A description was given of such facility, the normal radiological effluents, and a maximum credible accident. The estimated normal annual radiological release was 0.005 curies. Although the ultimate capacity of the facility would be about 80,000 canisters of waste, corresponding to about 8,000 annual fuel requirements (AFR), the initial capacity will be substantially less. Even if one assumed that the annual release from the facility were associated with a single annual fuel requirement, the fission

product release per annual fuel requirement would be 0.005 Ci/AFR. Since the release of solid fission products and actinides from the model reprocessing plant is estimated at 1.004 Ci/AFR, the omission of waste repository effluents from the original Environmental Survey did not materially affect the releases shown in the Summary Table. However, the 0.005 Ci/AFR value has been added to the 1.004 Ci/AFR value in the Summary Table for a combined total, when rounded off, of 1.01 Ci/AFR. While such a waste storage facility has not been constructed, preliminary conceptual designs have been developed using existing technology based on well established data and techniques.

The Commission believes that the Survey and hearing record provide an adequate data base for the regulation adopted. Revisions to the chemical effluents in Table S-3 have been made to reflect corrections or suggestions entered into the hearing record on UF_6 conversion facilities, UO_2 conversion plants and mining operations. Minor corrections with respect to radioactive effluents have been made and in no case do these corrections increase the effluent effects by more than .25 percent of natural background. To conform the table precisely to the text of the Survey, the values for iodine-129 and 131 releases have been changed from .002 and .02 curies to .0024 and .024 curies, respectively. In addition, values for exposure of workers and the general public in the transportation of radioactive materials covered in the Survey have been added to the Summary Table. To incorporate these changes, to incorporate data on the retrievable surface storage facility in high level wastes described in the hearing, and to add information suggested in comments received as a part of the hearing record, the Environmental Survey has been revised and is being issued in revised form concurrently with promulgation of this

amendment.³ In view of the fact that these revisions are minor and reflect the record already developed, we see no occasion for reopening this proceeding.

A third area in which issues were identified by the presiding hearing board relates to the Environmental Survey's use of qualitatively styled and allegedly undefined descriptive phrases for its conclusions regarding the magnitude of the environmental impact. One issue is whether the Survey should be revised to define more precisely the magnitude and anticipated ranges of variables pertinent to an assessment of the environmental impact. The Summary Table, S-3, to be used as a basis for evaluating the environmental effects in a cost-benefit analysis for a reactor quantifies all releases, and relates maximum effects to recognizable standards where practical. The Commission believes that providing ranges of variables relevant to assessing environmental impact would serve little or no constructive purpose here since conservatism was utilized in deriving the Summary Table values, and thus, these values already reflect an environmental impact greater than that which is truly anticipated. In addition, developing a range of values would have required separate investigations of multiple factors at over 150 mines, some 19 mills, 2 conversion plants, 3 enrichment plants, and 10 fuel fabrication facilities — to arrive at a range of values augmenting numbers already reflecting substantial conservatism.

Another issue identified in this area is whether more extensive analyses of the long-term environmental effects of waste storage and disposal are necessary to sustain the validity of the conclusions in the Survey. The Commission

³ Among other things, the revised Survey refers to and gives excerpts from an analysis by the Environmental Protection Agency that show that the CNL/UCS analysis of the Nuclear Fuel Services operation does not accurately represent the most recent operating history of NFS.

believes that sufficient data were presented regarding engineered waste storage facilities to justify the conclusion that the contribution of waste storage and disposal to the total environmental impact of the fuel cycle is relatively insignificant. However, as more information on high level waste storage and disposal systems becomes available as a result of the environmental impact statement on high level waste storage referenced earlier, a more definitive assessment of the environmental impact can be undertaken and the Survey revised accordingly, as appropriate.

The third issue raised in this area is whether the averaging of environmental effects and the use of models for each fuel cycle step produced values sufficiently conservative to warrant the Survey's conclusion of negligible environmental impact. The "model" facilities defined for the Environmental Survey represent the true industry average for the UF₆ conversion, enrichment, and reprocessing portions of the fuel cycle. The model mill size chosen is near the upper range of mill sizes, and the major environmental effects from milling result from the airborne effluents and tailings waste disposal steps common to all mills. Choosing a relatively large mill as a basis tended to make local environmental effects large, and hence conservative. The fuel fabrication model plant is typical of two plants that produce about 60 percent of the fuel manufactured in the United States today and conservatively represents the remainder. The effluents from the model facility were estimated without taking credit for recently installed pollution-abatement equipment and the distance from the plant to the near site boundary of the model represents the smallest distance of any actual fuel fabrication plant. These model and effluent characteristics produce conservative estimates of environmental effects.

A fourth area in which the hearing board identified an issue relates to suggestions for revision and re-examination

of the Environmental Survey at periodic intervals. While the Commission agrees with the suggestions that the Survey be re-examined from time to time to appropriately accommodate new technology and information, it does not believe it necessary or advisable to impose any specific time limit. In our view, revision should be based on growth in the data base, not on any fixed and arbitrary time period. Should future revisions to the Survey necessitate changes in the Summary Table, further rule making will be undertaken and the public afforded an opportunity for comment.

A fifth issue identified by the hearing board is whether any provision should be made for exempting or limiting the applicability of a final rule insofar as pending licensing cases are concerned. In view of the fact that the environmental effects of the uranium fuel cycle have been shown to be relatively insignificant, the Commission believes that it is unnecessary to apply the amendment to applicant's environmental reports submitted prior to its effective date or to Final Environmental Statements for which Draft Environmental Statements have been circulated for comment prior to the effective date. However, Draft Environmental Statements prepared but not circulated for comment prior to the effective date will be revised in accordance with the provisions of the amendment.

The sixth issue identified is whether the Commission should re-examine the proposed "Alternatives" in light of the record of the proceeding to determine whether modifications are necessary or desirable. In reviewing the record of the rule making hearing the Commission finds general approval for its generic approach to the consideration to be given to the environmental effects associated with the uranium fuel cycle. Many participants advocated adoption of one alternative or the other, other participants proposed modified versions of the alternatives, and one participant

advocated adoption of a third alternative which was discussed earlier. After examining these proposals, and after re-examining its own proposed alternatives, the Commission has adopted a slightly modified version of Alternative 2. The Commission, as did many of the hearing participants and commentators, favors the approach of Alternative 2 over that of Alternative 1 because the former conforms with the requirements of subsections 3 and 8 of section A of Appendix D to 10 CFR Part 50 in that it quantifies, to the fullest extent practicable, the environmental effects of the uranium fuel cycle in individual cost-benefit analyses. Incorporation of the Summary Table values into cost-benefit analyses in environmental reports and detailed statements will also help to assure more complete and meaningful documents. The changes in the effective amendment are clarifying and editorial in nature.

The seventh issue identified is whether further clarification is necessary to make clear that the Environmental Survey and the Summary Table of values are purely descriptive and are not intended as operating limits which may be imposed in licensing and regulatory actions with respect to the various fuel cycle facilities. Neither the effective amendment nor the Environmental Survey state or imply that the values in the Summary Table are to be imposed as operating limits on present and future fuel cycle facilities. Such limits are established and governed by other AEC regulations, principally, the provisions of Part 20 of Title 10 of the Code of Federal Regulations, "Standards for Protection Against Radiation." Further clarification is considered unnecessary.

The presiding hearing board raised two additional items which it believed merited Commission attention. The first was more in the nature of a suggestion to the Commission that the Regulatory staff be directed to assure the ready

availability of the background references, reference materials, and various calculations which served as the basis for the conclusions in the Survey. Copies of all non-copyrighted material, together with prior drafts of the Environmental Statement marked up by the staff, and over 100 pages of handwritten calculations were given to the Public Document Room on January 5, 1973. Therefore, the Commission believes that the staff had already complied with this suggested directive by making these background references, uncopyrighted reference materials, previous drafts and the various calculations available in the AEC's Public Document Room.

The second item referred to is whether the Environmental Survey should have discussed alternative processes with regard to fuel cycle operations. The purpose of the Survey was to provide a data base from which numerical values could be derived which would reflect the environmental impact associated with the uranium fuel cycle. These values would then be factored into cost-benefit analyses for individual reactors under the alternative adopted. Whenever possible, Survey data were based on actual operating fuel cycle facilities in order to produce numerical values reflecting real or actual environmental impact. Where this was not possible, conservatism was utilized. As stated earlier, the Environmental Survey is not an impact statement, and therefore, a discussion of alternatives is not required. In addition, the Commission does not believe that the Survey is the appropriate place to discuss alternatives in view of the fact that alternatives are considered in the NEPA context in individual licensing actions on fuel cycle facilities. On the basis of the foregoing and consideration of the comments received, the record of the hearing and other factors involved, the Commission has adopted the amendment set forth below. The amendment is essentially identical to the

second alternative contained in the November 15, 1972 FEDERAL REGISTER notice (37 FR 24191), except for minor clarifying and editorial changes.

Pursuant to the Atomic Energy Act of 1954, as amended, and sections 552 and 553 of Title 5 of the United States Code, the following amendment to Appendix D to 10 CFR Part 50 is published as a document subject to codification.

1. A new subsection 15 is added to section A to read as follows:

15. (a) In applicant's environmental reports and the Commission's detailed statements for light-water-cooled nuclear power reactors, the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor, shall be as set forth in the following Table S-3 of the Commission's "Environmental Survey of the Uranium Fuel Cycle." No further discussion of such environmental effects shall be required.

(b) This section does not apply to any applicant's environmental report submitted pursuant to section 4 prior to June 6, 1974, or to any Final Environmental Statement for which a Draft Environmental Statement had been circulated for comment prior to June 6, 1974.

Effective date. The foregoing amendment is effective on June 6, 1974.

(Sec. 161, Pub. L. 83-703, 68 Stat. 948; Sec. 102 Pub. Law 91-190, 83 Stat. 853; (42 U.S.C. 2201, 4332)).

Dated at Washington, D.C. this 16th day of April 1974.

For the Atomic Energy Commission.

PAUL C. BENDER,
Secretary of the Commission.

TABLE 2-1. — Summary of environmental considerations for uranium fuel cycle
[Normalised to model LWR annual fuel requirement]

Natural resource use	Total	Maximum effect per annual fuel requirement of model 1,000 MWe LWR
Land (acres):		
Temporarily committed.....	63	
Undisturbed area.....	48	
Disturbed area.....	18	Equivalent to 90 MWe coal-fired powerplant.
Permanently committed.....	4.6	
Overburden moved (millions of MT).....	2.7	Equivalent to 90 MWe coal-fired powerplant.
Water (millions of gallons):		
Discharged to air.....	156	
Discharged to water bodies.....	11,040	≈2 percent model 1,000 MWe LWR with cooling tower.
Discharged to ground.....	123	
Total.....	11,319	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)....	317	<5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT).....	118	Equivalent to the consumption of a 45 MWe coal-fired powerplant.
Natural gas (millions of scf).....	92	<0.3 percent of model 1,000 MWe energy output.
Effluents—chemical (MT):		
Gases (including entrainment): ¹		
SO ₂	4,400	
NO _x	1,177	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons.....	13.5	
CO.....	28.7	
Particulates.....	1,156	
Other gases:		
F.....	.73	Principally from UF ₆ production enrichment and reprocessing. Concentration within range of state standards—below level that has effects on human health.
Liquids:		
SO ₂	10.3	
NO _x	28.7	
Fluoride.....	12.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH ₃ —600 cfs. NO _x —20 cfs. Fluoride—70 cfs.
Ca++.....	5.4	
Cl.....	8.0	
Na+.....	16.9	
NH.....	11.3	
Fes.....	.4	
Tailings solutions (thousands of MT)....	340	From mills only—no significant effluents to environment.
Solids.....	91,000	Principally from mills—no significant effluents to environment.
Effluents—Radiological (curies):		
Gases (including entrainment):		
Ra-223.....	75	Principally from mills—maximum annual dose rate <4 percent of average natural background within 5 mi of mill. Results in 0.06 man-rem per annual fuel requirement.
Ra-226.....	.03	
Th-230.....	.03	
Uranium.....	.033	
Tritium.....	10.7	Principally from fuel reprocessing plants—Whole body dose is 6 man-rem per annual fuel requirement for population within 50 mi radius. This is <0.005 percent of average natural background dose to this population. Release from Federal Waste Repository of 0.005 Ci/yr has been included in fission products and transuranics total.
Kr-85 (thousands).....	330	
I-129.....	.0024	
I-131.....	.024	
Fission products and transuranics.....	1.01	
Liquids:		
Uranium and daughters.....	2.1	Principally from milling—included in tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra-226.....	.0034	From UF ₆ production—concentration 5 percent of 10 CFR 20 for total processing of 27.5 model LWR annual fuel requirements.
Th-230.....	.0015	
Th-234.....	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Ra-108P.....	.15	From reprocessing plants—maximum concentration 4 percent of 10 CFR 20 for total reprocessing of 26 annual fuel requirements for model LWR.
Tritium (thousands).....	2.5	
Solids (buried):		
Other than high level.....	601	All except 1 Ci comes from mills—included in tailings returned to ground—no significant effluent to the environment, 1 Ci from conversion and fuel fabrication is buried.
Thermal (billions).....	2,360	<7 percent of model 1,000 MWe LWR.
Transportation (man-rem): Exposure of workers and general public.....	.334	

¹ Estimated effluents based upon combustion of equivalent coal for power generation.

² 1.3 percent from natural gas use and process.

³ Co-137 (0.075 Ci/APR) and Sr-90 (0.004 Ci/APR) are also omitted.

(FR Doc. 74-6076 Filed 4-19-74; 2:45 am)

STATUTES AND REGULATIONS INVOLVED**1. Administrative Procedure Act §4, 5 U.S.C. § 553 (1970)**

(a) This section applies, according to the provisions thereof, except to the extent that there is involved —

(1) a military or foreign affairs function of the United States; or

(2) a matter relating to agency management or personnel or to public property, loans, grants, benefits, or contracts.

(b) General notice of proposed rule making shall be published in the Federal Register, unless persons subject thereto are named and either personally served or otherwise have actual notice thereof in accordance with law. The notice shall include —

(1) a statement of the time, place, and nature of public rule making proceedings;

(2) reference to the legal authority under which the rule is proposed; and

(3) either the terms or substance of the proposed rule or a description of the subjects and issues involved.

Except when notice or hearing is required by statute, this subsection does not apply —

(A) to interpretative rules, general statements of policy, or rules of agency organization, procedure, or practice; or

(B) when the agency for good cause finds (and incorporates the finding and a brief statement of reasons therefor in the rules issued) that notice and public procedure thereon are impracticable, unnecessary, or contrary to the public interest.

(c) After notice required by this section, the agency shall give interested persons an opportunity to participate in the rule making through submission of written data, views, or arguments with or without opportunity for oral presentation. After consideration of the relevant matter presented,

the agency shall incorporate in the rules adopted a concise general statement of their basis and purpose. When rules are required by statute to be made on the record after opportunity for an agency hearing, sections 556 and 557 of this title apply instead of this subsection.

(d) The required publication or services of a substantive rule shall be made not less than 30 days before its effective date, except —

(1) a substantive rule which grants or recognizes an exemption or relieves a restriction;

(2) interpretative rules and statements of policy; or

(3) as otherwise provided by the agency for good cause found and published with the rule.

(e) Each agency shall give an interested person the right to petition for the issuance, amendment, or repeal of a rule. Pub.L. 89-554, Sept. 6, 1966, 80 Stat. 383.

2. *Atomic Energy Act of 1954* § 189, 42 U.S.C.
§ 2239 (1970)

CHAPTER 16. JUDICIAL REVIEW AND ADMINISTRATIVE PROCEDURE

Section 189 (42 U.S.C., §2239)—Hearings and Judicial Review.—(a) In any proceeding under this chapter, for the granting, suspending, revoking, or amending of any license or construction permit, or application to transfer control, and in any proceeding for the issuance or modification of rules and regulations dealing with the activities of licenses, and in any proceeding for the payment of compensation, an award or royalties under sections 2183, 2187, 2236(c) or 2238 of this title, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding. The Commission shall hold a hearing after thirty days' notice and publication once in the Federal Register, on each application under section 2133 or 2134(b) of this title for a construction permit for a facility, and on any application under section 2134(c) of this title for a construction permit for a testing facility. In cases where such a construction permit has been issued following the holding of such a hearing, the Commission may, in the absence of a request therefor by any person whose interest may be affected, issue an operating license or an amendment to a construction permit or an amendment to an operating license without a hearing, but upon thirty days' notice and publication once in the Federal Register of its intent to do so. The Commission may dispense with such thirty days' notice and publication with respect to any application for an amendment to a con-

struction permit or an amendment to an operating license upon a determination by the Commission that the amendment involves no significant hazards consideration.

(b) Any final order entered in any proceeding of the kind specified in subsection (a) of this section shall be subject to judicial review in the manner prescribed in the Act of December 29, 1950, as amended, and to the provisions of section 10 of the Administrative Procedure Act, as amended.

s. 10 CFR § 51.20(e) (1976)

(e) In the Environmental Report required by paragraph (a) for light-water-cooled nuclear power reactors, the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor, shall be as set forth in the following table. No further discussion of such environmental effects shall be required.

TABLE S-3. — Summary of environmental considerations for uranium fuel cycle
[Normalised to model LWR annual fuel requirement]

Natural resource use	Total	Maximum effect per annual fuel requirement of model 1,000 MWe LWR
Land (acres):		
Temporarily committed.....	63	
Undisturbed area.....	45	
Disturbed area.....	18	Equivalent to 90 MWe coal-fired powerplant.
Permanently committed.....	4.6	
Overburden moved (millions of MT).....	2.7	Equivalent to 90 MWe coal-fired powerplant.
Water (millions of gallons):		
Discharged to air.....	156	
Discharged to water bodies.....	11,040	≈2 percent model 1,000 MWe LWR with cooling tower.
Discharged to ground.....	123	
Total.....	11,319	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)....	317	
Equivalent coal (thousands of MT).....	115	<5 percent of model 1,000 MWe LWR output. Equivalent to the consumption of a 45 MWe coal-fired powerplant.
Natural gas (millions of scf).....	92	<0.2 percent of model 1,000 MWe energy output.
Effluents—chemical (MT):		
Gases (including entrainment):¹		
SO ₂	4,400	
NO _x ²	1,177	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons.....	13.5	
CO.....	28.7	
Particulates.....	1,156	
Other gases:		
F.....	.72	Principally from UF ₆ production enrichment and reprocessing. Concentration within range of state standards—below level that has effects on human health.
Liquids:		
SO ₂	10.3	
NO _x	26.7	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH ₃ —600 cfs. NO _x —20 cfs. Fluoride—70 cfs.
Fluoride.....	12.9	
Ca ⁺⁺	5.4	
Cl ⁻	8.6	
Na ⁺	16.9	
NH ₃	11.5	
Fe.....	.4	
Tailings solutions (thousands of MT)....	340	From mills only—no significant effluents to environment.
Solids.....	91,000	Principally from mills—no significant effluents to environment.
Effluents—Radiological (curies):		
Gases (including entrainment):		
Ra-222.....	75	
Ra-226.....	.02	Principally from mills—maximum annual dose rate <4 percent of average natural background within 5 mi of mill. Results in 0.06 man-rem per annual fuel requirement.
Th-230.....	.02	
Uranium.....	.032	
Tritium (thousand).....	16.7	
Kr-85 (thousands).....	350	Principally from fuel reprocessing plants—Whole body dose is 6 man-rem per annual fuel requirements for population within 50 mi radius. This is <0.007 percent of average natural background dose to this population. Release from Federal Waste Repository of 0.006 Ci/yr has been included in fission products and transuranics total.
I-129.....	.0024	
I-131.....	.024	
Fission products and transuranics.....	1.01	
Liquids:		
Uranium and daughters.....	2.1	Principally from milling—included in tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra-226.....	.0034	
Th-230.....	.0015	From UF ₆ production—concentration 5 percent of 10 CFR 20 for total processing of 27.5 model LWR annual fuel requirements.
Th-234.....	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Ra-106 ³15	
Tritium (thousands).....	2.5	From reprocessing plants—maximum concentration 4 percent of 10 CFR 20 for total reprocessing of 26 annual fuel requirements for model LWR.
Solids (buried):		
Other than high level.....	601	All except 1 Ci comes from mills—included in tailings returned to ground—no significant effluent to the environment, 1 Ci from conversion and fuel fabrication is buried.
Effluents—Thermal (billions of British Thermal Units).....	3,380	<7 percent of model 1,000 MWe LWR.
Transportation (man-rem): Exposure of workers and general public.....	.334	

¹ Estimated effluents based upon combustion of equivalent coal for power generation.

² 1.3 percent from natural gas use and process.

³ Co-137 (0.075 Ci/AFR) and Sr-90 (0.004 Ci/AFR) are also emitted.